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Findings on Health Status and Health Care Needs

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HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEY, 1982–84:

Findings on Health Status and Health Care Needs

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FOREWORD

In 1986 the National Coalition of Hispanic Health and Human Services Organizations (COSSMHO) established the Hispanic Health Research Consortium (HHRC) to spearhead analysis of the landmark Hispanic Health and Nutrition Examination Survey (HHANES). Conducted by the National Center for Health Statistics (NCHS), HHANES was the first representative survey to provide physical examination information on the health and nutritional status of Mexican Americans, Puerto Ricans, and Cuban Americans.

HHRC was established when COSSMHO entered into an agreement with the Office of the Assistant Secretary for Health (OASH) in the US Department of Health and Human Services and the National Center for Health Statistics to facilitate research by nongovernment sources on the data from the HHANES. Two rounds of competitive grants were awarded by COSSMHO to establish a network of eight university and community-based research teams. COSSMHO coordinated the research of this network, provided technical assistance, convened meetings of HHRC researchers, and disseminated information nationally to researchers interested in conducting HHANES analyses.

The unique partnership between COSSMHO, OASH, NCHS, and university and community-based researchers ensured that there would be: support for HHANES research in critical areas; appropriate outreach to Hispanic researchers and those who have developed a reputation for their work on health in Hispanic communities; support for graduate level students to conduct research on the health status of Hispanic communities; and hopefully the development of a pool of future research talent. The establishment of the Hispanic Health Research Consortium has moved the analysis of Hispanic health care issues to a new level of sophistication.

The information presented in this supplement and available for HHANES represents a significant increase in our nation's ability to examine and understand the health of Hispanic Americans. It is our hope that this publication and subsequent analyses of HHANES data will provoke thought and debate and will serve as an impetus for new research on the health status and health care needs of our nation's 23 million Hispanic men, women, and children.

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I. Hispanic Health and Nutrition Examination Survey: Methodological Considerations

Jane L. Delgado, PhD, Clifford L. Johnson, MSPH, Ila Roy, MSW, and Fernando M. Treviño, PhD, MPH

Abstract: The Hispanic Health and Nutrition Examination Survey (HHANES) was the first special population survey undertaken by the National Center for Health Statistics. The HHANES was designed to assess the health and nutritional status and needs of Mexican Americans, mainland Puerto Ricans and Cuban Americans. Data were collected using five data collection techniques: direct physical examinations, diagnostic testing, anthropometry, laboratory analyses, and interviews. Unlike other surveys conducted by the National Center for Health Statistics, the HHANES was not designed as a national survey. The HHANES was a survey of three Hispanic subgroups of the population in selected areas of the United States with a survey universe that included approximately 76 percent of the 1980 Hispanic-origin population in the United States. This article discusses statistical issues that should be addressed by researchers when analyzing HHANES data. Specifically, analysts need to account for the complex sample design, nonresponse bias, potential non-coverage bias, and the regional nature of the HHANES sample. [*Am J Public Health* 1990; 80(Suppl):6–10.]

Introduction

HHANES is the largest and most comprehensive Hispanic health survey ever carried out in the United States. It collected a wide spectrum of socioeconomic, health and demographic data; administered physical and dental examinations; took diagnostic specimens and conducted specialized tests, producing one of the most complete and unique Hispanic health data bases available to date.

History

The roots of the survey can be traced to 1977 when the National Academy of Public Administration was contracted to evaluate the National Health and Nutrition Examination Survey (NHANES). An expert panel, formed to assess NHANES utility in addressing nutrition-related public health issues, recommended that the National Center for Health Statistics (NCHS), the agency of the Public Health Service commissioned to carry out NHANES, should consider studies of the health and nutrition status of major subpopulation groups which could yield estimates comparable to those of the general US population.[1] The Hispanic population was subsequently selected as the special population group to be surveyed due to its size and the lack of available health status data. This study enables researchers to compare results available for the general population.

Planning for the survey began in 1979 with actual data collection occurring over a two-year period (1982–84) in three regions of the United States. HHANES surveyed Hispanics from the three major Hispanic subgroups as indicated by the 1980 Census: Mexican Americans, Puerto Ricans and Cuban Americans. Analysis of HHANES data began in earnest in 1986 when agreements were entered into with the National Coalition of Hispanic Health and Human Services Organizations (COSSMHO) to establish the Hispanic Health Research Consortium (HHRC).

Design

HHANES became the first special population survey undertaken by the National Center for Health Statistics to assess the health and nutritional status and needs of Hispanics and to investigate the access to services by this population. HHANES was designed to focus on certain selected chronic conditions rather than to provide a comprehensive picture of health status or total need for care.[2] It was also intended to provide baseline health and nutritional information for Hispanics comparable to other surveys conducted by NCHS, particularly the Second National Health and Nutrition Examination Survey (NHANES II).[3]

The stated goals of HHANES were: to conduct a study of the health and nutritional status of the Hispanic population; to produce information useful for public health planners and researchers; and to stimulate further research and investigations on Hispanic health issues. The types of information that health examination surveys contribute are related to specific conditions or measures and include: total prevalence of a condition or characteristic, descriptive or normative information, and relationships between health variables and demographic factors. HHANES was designed to enable the study of all of these aspects of health.

The major chronic conditions studied by HHANES were: diabetes, hypertension, heart disease, gallstones, dental disease, otitis media and hearing problems, kidney disease, liver function, and depression. In addition, it surveyed the prevalence of immunization, alcohol consumption, cigarette consumption, and drug abuse in the population. HHANES also had as a major focus nutritional status, nutrition-related conditions (iron status and anemia, Vitamin A levels), and food consumption patterns as related to overweight, diabetes, alcohol consumption, dental health, and digestive diseases. Environmental exposure was a final aspect of the survey that measured exposure by the sample population to lead and selected pesticides.

Apart from these medical issues, questionnaires included numerous demographic and economic items. Income assistance, insurance coverage, health services use and satisfaction, acculturation, and assessment of health (both self-assessment and physician assessment) are examples of information collected on the various questionnaires for each sample person.

The Acculturation Scale

Many of these subjects are critical factors in the analyses of HHANES data, but pose special problems of their own. For example, the complex nature of acculturation makes it difficult to sort out this factor as a mediator of health problems. The eight variable acculturation scale used in the HHANES was modified from a 20-item scale developed for

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Note: Author affiliations are listed elsewhere under CONTRIBUTORS.

and validated with a Mexican origin population.[4] It was not designed to assess acculturation levels of Puerto Ricans or Cuban Americans. The eight item HHANES acculturation scale assessed language ability, self-identification, parents' ethnic identification and generation in the US. Sample persons were asked: 1) what language do you speak? 2) What language do you prefer? 3) Can you read Spanish? English? Which do you read better? 4) Can you write Spanish? English? Which do you write better? 5) How do you identify yourself? 6) What ethnic identification does/did your mother use? 7) What ethnic identification does/did your father use? and 8) Where were you born? Your mother? Your father? Each of the first seven variables is scaled from 1 to 5, where 1 represents the least acculturated category and 5 represents the most acculturated category. Variable 8 (birthplace) cannot be scaled from 1 to 5, as it was in the original scale, because of gaps in the data collected in the HHANES. In the original scale developed by Cuellar, *et al*, a first generation American was scored as a "1" (born in Mexico) and a fifth generation person was scored as a "5". The HHANES did not collect information regarding grandparents' birthplace, thus persons could only be classified as being first, second, and third or higher generation Americans. Persons who were not born in Mexico and whose parents were also not born in Mexico were coded as a "4" (third or higher generation). Nonetheless, the detailed nature of the instruments developed and administered by the HHANES has the great potential to provide a uniquely rich picture of various aspects of illness, health, and health service use (as well as barriers) in the Hispanic population.

The Target Population

It is important to note that HHANES was not designed as a national Hispanic survey; therefore, no national estimates for Hispanics can be drawn based on HHANES findings. The major difference between HHANES and previous NHANES surveys is that HHANES was a survey of three Hispanic subgroups of the population in selected areas of the United States rather than a national probability sample. Even though HHANES was not designed to be representative of all Hispanics residing in the United States, the survey universe included approximately 76 percent of the 1980 Hispanic-origin population in the United States. The three Hispanic subgroups and the area covered were: Mexican Americans residing in five southwestern states (Arizona, California, Colorado, New Mexico and Texas); Cuban-Americans residing in Dade County, Florida; and Puerto Ricans residing in the New York City metropolitan area including parts of New York, New Jersey, and Connecticut.

The target population for HHANES ideally would have been all households in the United States with at least one member of Hispanic origin. However, there are many states and counties with very small numbers or proportions of Hispanic persons. Therefore, HHANES was restricted to those areas of the country described above in order to permit an efficient operation of the survey from the standpoints of cost and logistics. Even within the areas defined for the survey, there were certain counties excluded from the survey design for the same reasons. This may result in some small bias due to noncoverage. The sample weights created for analysis and estimation purposes attempt to take into account this issue of noncoverage.

Sampling and Respondent Selection

Survey results can be generalized to these subgroups and geographic areas. The design included identification of three universes: a Mexican-origin universe made up of 193 primary sampling units (PSUs) in five Southwestern States (Texas, Colorado, New Mexico, Arizona and California); a Cuban-origin universe consisting of one PSU (Dade County, Florida); and a Puerto Rican-origin universe consisting of 16 PSUs from New York, New Jersey, and Connecticut. The PSUs were stratified to group similar counties and one was selected from each stratum. Finally, segments and households were selected from each PSU.

Within each PSU, block areas with less than a minimum number of eligible Hispanics were excluded due to the costs of interviewing ineligible households. This exclusion should be considered during interpretation of the results. Households which had at least one Hispanic member (for example, a Mexican American in the Southwest) were eligible to participate; therefore it should be noted that a small percent of non-Hispanics are included in the overall sample.

Selected households were screened to identify eligible Hispanic families and to select sample persons from these families to be interviewed and examined. Eligibility for the survey was determined by the family unit. A family was considered to be eligible if at least one family member's reported national origin or ancestry met the criteria for eligibility appropriate to the survey location. In cases where multiple origins were reported for the same person on different questionnaires in the survey, the person was considered eligible if any one of the reported origins met these criteria.

If a family was eligible for the survey, then every member of that family was eligible to be selected for the interview and examination procedures. Therefore, some non-Hispanic persons residing in Hispanic households and some Hispanic persons not meeting the above criteria were selected for the survey and examined. Thus, analysis of HHANES data can be done in one of two ways. If all sample persons are included, then the analysis is of Hispanic households (which may include non-Hispanic individuals). If only sample persons meeting the eligibility criteria are included, then the analysis is of Mexican Americans, Cuban Americans, or Puerto Ricans, respectively.

Data Collection

HHANES relied on five data collection techniques: direct physical examinations, diagnostic testing, anthropometry (body measurements), laboratory analyses, and interviews. Depending on the nature of the interviews, some were administered in the household and others were administered in private within a mobile examination center. All examinations and testing were performed in the mobile examination center located in the community.

Due to the survey's modus operandi, attrition occurred both at the in-house interviews and at a later examination in the mobile trailer. The attrition of sample persons to the health examination occurred for a variety of reasons, e.g. had undergone a recent examination, fear of having an examination, lack of time, etc. Therefore, there are interview data on a larger sample than examination data.

Oral glucose tolerance tests and an ultrasound examination of the gall bladder were administered to a half-sample of the adult population; these people were asked to fast overnight and were examined in the morning sessions.

Caution should be exercised when utilizing data from certain specialized examinations. Due to the intrusive and demanding nature of the tests, or special requirements placed to ensure accurate testing, a low response rate resulted, particularly in the case of the glucose tolerance test.

Virtually all interview staff involved in the survey were bilingual; most were also bicultural.

Response Rates

NCHS has estimated that the HHANES survey represented approximately 76 percent of the total 1980 US Hispanic civilian, noninstitutionalized population aged 6 months through 74 years. Table 1 shows the sample sizes and response rates for each of the three survey areas in HHANES. The results are presented for both the total sample and the specific origin sample as explained previously.

Statistical Guidelines

Each of the authors of the articles in this supplement was provided with detailed statistical guidelines. Because the Health and Nutrition Examination Surveys have used a complex survey design rather than a simple random sample design, standard statistical methods may not be appropriate for data analysis. Guidelines for NHANES data analysis which produce the appropriate covariance structure and population estimates have been described elsewhere, and will only be summarized here.[2,5] Sample weights must be used to produce correct population estimates since each sample person does not have an equal probability of selection. The weights incorporate the selection probabilities, and adjustments for post-stratification (in the Mexican American sample only), noncoverage and nonresponse. In addition to the sample weights, the strata and the primary sampling units from the sample design are needed to estimate the sample variances and to test for statistical significance. In general, sampling variances will be underestimated if calculated without incorporating the complex sample design. (*Note:* the complex sample estimate of sampling variance includes variability due to measurement error).

The effect of the complex sample design on variance estimates is reflected by the design effect, which is the ratio of the variance of a statistic from a complex sample to the variance of the same statistic from a simple random sample of the same size.[2] A design effect of one indicates the equality of the simple random sample variance and the complex sample variance.

TABLE 1—Sample Size and Response Rates by Survey Area and Specified Hispanic Origin: Hispanic Health and Nutrition Examination Survey, 1982–84

Survey Area and Hispanic Origin	Sample Size	Interviewed		Examined	
		No.	Percent	No.	Percent
Southwest area					
All Persons	9,894	8,554	86.5	7,462	75.4
Mexican American	9,455	8,222	87.0	7,197	76.1
Dade County, Florida area					
All Persons	2,244	1,766	78.7	1,357	60.5
Cuban	2,125	1,677	78.9	1,291	60.8
New York City area					
All Persons	3,786	3,369	89.0	2,834	74.9
Puerto Rican	3,525	3,137	89.0	2,645	75.0

However, design effects in NHANES I and II were rarely one, and the magnitude of the design effects was highly variable. Although preliminary analyses may be performed on unweighted data with standard statistical packages that assume simple random sampling, final analyses should be done on weighted data using special computer programs that use a balanced half-sample replication methods (e.g. SESUDAAN, SURREGR) which incorporate the complex sample design.[6,7]

The complex survey design with effects greater than 1 also increase the minimum sample size needed for calculation of reliable estimates of statistical parameters. The sample size requirements were calculated assuming an average design effect of 1.5. The approach was also used in the initial analyses of the HHANES data, because HHANES also used a complex sample design. However, analyses performed during data editing revealed a number of unexpectedly large (>7.5) or small (<.8) design effects.[8] The unstable variance estimates did not show a consistent pattern, nor were they alleviated by using different methods of estimating variances, stratifying, or incorporating the third level of sampling. In general, then, calculating point estimates of sample variances by using the special computer programs described earlier cannot be recommended. An interim recommendation to use average design effects to correct variances based on the assumption of simple random sampling was made for HHANES data analysis. This is not the only approach that could be used to deal with this issue. It is, however, a relatively simple and practical solution. The impact of using this approach for various types of analyses is discussed in following chapters.

Average design effects have since been calculated for many analytic variables for the three Hispanic subgroups. In general, the average design effects for the Mexican American and Puerto Rican subgroups tend to average 1.5, while those for the Cuban subgroup tend to be about 1. Thus, in developing preliminary guidelines for analysis and presentation of HHANES data, these differences in design should be considered.

Criteria for Presentation of Data

Using the information described above about the effects of the HHANES complex survey design, the following guidelines were developed for the reporting of means and percents for the HHANES data:

- If the sample size in an analytic cell is less than 25, the mean or percent should not be reported;
- If the sample size is 25–44, the mean or percent should be reported with an asterisk beside it to indicate that the statistic does not meet a minimum reliability standard;
- If the sample size is 45 or more, the mean or percent is presented without caveat.

Exceptions to these guidelines are possible in selected instances in order to more completely present a series of findings, as long as the appropriate caveats are clearly indicated.

Multivariate Analyses

Multivariate analyses should be performed in three stages as recommended by Landis, *et al*,[5] and Kovar.[8] The first stage involves running the multivariate analyses without regard to the weights or complex sampling design. The second stage consists of running the same analyses incorporating the sample weights. The third and final stage involves running the same analyses incorporating the sample weights and the complex survey design.

The second and third stages of analyses can use a transformation or "Standardization" of the statistical weight variable to arrive at unbiased test statistics. To normalize the weights to the actual sample size of the analytic sample the following equation is used:

> Normal Weight per sample person = (individual weight) * (actual sample size of analytic sample/the sum of the weights of the analytic sample).

Analysts should use software packages or procedures in stage three analyses that incorporate the complex survey design (e.g. SURREGR and SUPER CARP).[7,9] If this is not possible, other standard software packages or procedures (e.g. SAS PRICER) can be used.[10] In this latter situation, using the normalized weights and exercising caution in interpreting test statistics is essential. For example, analysts need to consider whether a significant t-statistic for a Beta coefficient would remain significant with a design effect of 2.

This can be accomplished by multiplying the denominator of the t-statistic by the square root of 2. If the t-statistic would remain significant with a survey design effect of two (or even higher), then the analyst could feel fairly comfortable with the result. However, if the result would change with a design effect somewhere between one and two, then the interpretation of the finding should be qualified and supported by other findings in the literature.

Considerations of reliability of test statistics also require the stage three analyses incorporate some allowance for the variability as well as the size of the design effect. Analysts were advised to limit the number of independent variables per analysis to no more than the number of degrees of freedom for a given analysis, usually defined as the number of PSUs minus the number of strata (see B. V. Shah's discussion in the documentation for SURREGR). For example, separate regression analyses for NHANES II Whites and Blacks should include no more than 32 and 16 variables, respectively; and analyses of Mexican Americans, Cuban Americans, and Puerto Ricans should include no more than eight variables. For the same reason, (i.e. considerations of reliability), the forward approach is preferred to the backward approach in variable selection for regression analyses.

In summary, multivariate analyses should always be undertaken with a purpose in mind and caution in interpretation of the results. The complex NHANES and HHANES surveys with relatively small numbers of PSUs, and, in some cases, sample sizes, require the analyst to exercise good judgment and to realize that some of their analyses would result in more hypothesis-generating than answering.

Comparing NHANES and HHANES Results

The average design effect approach can be used to calculate complex sample variances for both NHANES data and HHANES data as described previously. This results in one common approach being used to handle the complex sample design for both surveys. A second approach involves calculating individual complex variance estimates from the appropriate software programs mentioned previously for all races and for Whites from NHANES I or NHANES II. These are combined with average design effect variance estimates for Blacks from NHANES I or NHANES II and Mexican Americans, Cuban Americans, and Puerto Ricans from HHANES. This mixed approach is much more difficult to explain to the reader, but is an acceptable alternative. Regardless of the approach selected, a t-statistic should be used in any statistical testing of differences between the various population groups.

Conclusions

It is important, apart from its specific scope, to be aware of the limitations of HHANES data in terms of the manner in which the sample design and response rates affect analyses and interpretation of the findings. The interpretation of results should be made with the following factors in mind:

- *HHANES does not have a simple random sample design.* Only weighted estimates are considered accurate in reflecting the sub-population to which the sample person participating in HHANES belongs. It is necessary, during analysis, to incorporate the sample weights provided by NCHS on each data tape. Because of the complex sample design and the ratio adjustments used to produce the sample weights, commonly used methods of point and variance estimation and hypothesis testing which assume simple random sampling may give misleading results.
- *Nonresponse bias in HHANES.* There exists the potential for three levels of nonresponse: household interview nonresponse, examination nonresponse, and item nonresponse. The potential effect of any nonresponse bias is greater when response rates are low. Therefore, intense efforts were undertaken during HHANES to develop and implement procedures and inducements that would reduce all types of nonresponse and thereby reduce the potential for bias in the survey estimates. Despite these efforts, a number of sample persons did not participate in the survey (see Table I). Therefore, it is important that any analysis of HHANES data include some assessment of the possible impact of nonresponse bias on the results.
- *Potential non-coverage bias in HHANES sample.* Due to the exclusion of areas with few Hispanic residents, there is a potential non-coverage bias in the HHANES sample that should be considered when interpreting results.
- *HHANES was not designed as a national Hispanic survey.* No national estimates for Hispanics can be drawn based on HHANES findings. Neither can the data for the three Hispanic subgroups be combined to produce a single estimate for the entire Hispanic population. Only regional estimates for the three subpopulations included are possible.

Due to its complex nature, it is important to be thoroughly familiar with the HHANES data base for its applicability to research areas under consideration and for analytical procedures suggested. This is facilitated by ample documentation now available on the subject as well as the documentation accompanying each data tape. When properly used, the HHANES data base constitutes an invaluable and unique resource for studying the health and nutritional status of the Hispanic population.

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II. Acculturation, Access to Care, and Use of Preventive Services by Hispanics: Findings from HHANES 1982–84

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Abstract: Use of preventive health services (physical, dental, and eye examinations, Pap smear and breast examinations) among Mexican American, Cuban American, and Puerto Rican adults (ages 20–74) was investigated with data from the HHANES. Analyses focused on the relative importance of two predictors of recency of screening: access to services (health insurance coverage, having a routine place for care, type of facility used, having a regular provider, travel time) and acculturation (spoken and written language, ethnic identification). Regression analyses controlling for age, education, and income indicated that utilization of the preventive services was predicted more strongly by access to care than by acculturation. For each Hispanic group, having a routine place for health care, health insurance coverage, and a regular provider were each significantly associated with greater recency of screening. Type of facility used and travel time produced less consistent effects. These results replicate past studies that have demonstrated the important link between institutional access and use of health services. Of the acculturation variables, language but not ethnic identification (which was measured only for the Mexican Americans) predicted use. This latter finding, which has been demonstrated in other studies as well, suggests that the effect of language on screening practices should not be interpreted as a cultural factor, but as an access factor, i.e. use of English favors access to services. [*Am J Public Health* 1990; 80 (Suppl):11–19.]

Introduction

Despite the steady improvement in the health status of Americans generally, Hispanics in the United States continue to be at greater risk for health problems.[1] This risk may stem, in part, from underutilization of screening services for the prevention and early detection of disease. Mexican Americans, for example, are less likely than non-Hispanic Whites to use such services as routine medical check-ups, dental and eye examinations, prenatal care, and family planning.[2–6]

Two general hypotheses can be invoked to account for Hispanics' underutilization of preventive health services. One hypothesis argues that level of acculturation of Hispanics influences their utilization patterns.[7–9] As discussed by Keefe,[10] acculturation is the process of change that occurs as a result of continuous contact between cultural groups. Although such a broad definition does not specify the types, degree, or direction of change expected, studies have largely presumed that Hispanics who have adopted the behavioral practices and values of the dominant society are more likely to utilize health services.[8]

Indirect support for this view comes from studies indicating that Mexican Americans used preventive services less than the general population,[3–5,11] even after controlling for sociodemographics and health insurance coverage. These studies, however, did not measure acculturation directly; thus they can only presume that the differences are due to cultural factors. Other studies have measured acculturation with multidimensional scales or with measures of language preference. Some suggest an effect of acculturation on utilization of health services,[6,12–14] whereas others fail to find an effect.[15–17] Despite these inconsistent results, a trend is apparent. Those studies that defined acculturation as language preference found that use of English related to use of oral contraceptives[13] and to fewer perceived barriers to medical care.[14] Further, a recent study[15] that examined several dimensions of acculturation (language, country of origin, contact with homeland, parental expectations of their children) found that language was the only dimension that predicted use of breast cancer screening among elderly Hispanic women; those who used English went for screening more recently. Taken together, these studies suggest that aspects of language may be especially important to our understanding of Hispanics' use of medical screening programs.

A second hypothesis attributes use of preventive health services to access to care. Access can be defined in terms of factors that influence the ease with which medical care can be obtained.[5] Such factors include the availability of health insurance, having a routine place of care and a regular provider, type of health care facility used and its proximity to residence.[5]

Compared to the general population, Hispanics are less likely to have health insurance coverage and less likely to have a routine place for obtaining health services.[5,18–21] This reflects their low income, low education, and employment in positions that do not provide insurance benefits.[4,5,22,23] Because of these barriers, they are more likely to rely on public health facilities, hospital outpatient clinics, and emergency rooms,[20,21,24,25] and are not likely to see a particular physician on an ongoing basis.[20] The "working poor" represent a segment of the Hispanic population that is especially vulnerable to access barriers in that they are neither able to afford the rising costs of medical services nor eligible for assistance through governmental programs.[21,26]

The present study provided a systematic examination of acculturation and access to care as factors influencing use of preventive health services by Hispanics. Unlike prior research on Hispanic health which has usually sampled only Mexican Americans, we examined three groups of Hispanics: Mexican Americans, Cuban Americans, and Puerto Ricans. Further, we measured use of an array of preventive services (e.g., routine physical, dental, and eye examinations, Pap smear, and breast examination).

Method

Sample

The data for our analyses were collected in the Hispanic Health and Nutrition Examination Survey (HHANES) conducted by the National Center for Health Statistics (NCHS) from 1982 through 1984. This survey sampled Mexican Americans from five southwestern states (California, Arizona, New Mexico, Texas, and Colorado), Cuban Americans from Dade County (Miami) Florida, and Puerto Ricans from

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the New York City area. For detailed information about the complex sampling design see the methodological paper[27] at the beginning of this supplement and NCHS plan and operation of HHANES.[28]

Selected sociodemographic information, as well as analytic sample sizes, are presented in Table 1. Analyses were restricted to eligible Hispanic sample persons between the ages of 20 and 74 who provided data on each variable used in the study. There were few cases of missing data. Of the total number of Mexican Americans, Cuban Americans, and Puerto Ricans (ages 20–74) sampled, 89 percent, 92 percent, and 93 percent, respectively, were included in the analytic samples.

Measures

Preventive Behavior—Utilization of preventive services was measured by responses to queries on seven service-related behaviors. The first item listed below was considered indicative of a person's tendency to *plan* his/her use of services, while the other six measures concerned recency of use of specific types of medical examinations.

- Individuals were asked whether or not they had made an appointment for their last visit to a health care setting.
- "About how long has it been since you had a *routine* physical examination, that is, not for a particular illness but for a general check-up?" (Responses were coded on a five-point scale ranging from "never" [1] to "less than one year ago" [5].)
- "About how long has it been since you last saw a dentist or dental hygienist for dental care?" (Responses were coded from "never" [1] to "six months ago or less" [6].)
- "When was the last time you had your vision tested?" ("Never" [1] to "six months ago or less" [6].)
- "About how long has it been since you last had your blood pressure taken?" ("Never" [1] to "six months ago or less" [4].)
- "About how long has it been since you had a Pap smear test for cancer?" ("Never" [1] to "less than one year ago" [8], females only.)
- "About how long has it been since you had your breasts examined by a doctor or other health professional?" ("Never" [1] to "less than one year ago" [8], females only.)

Preliminary analyses revealed that, for each sample, responses to these seven measures were positively correlated (*r* .11 to .74). Thus, we created a preventive index for each respondent separately for each sample. Each of the seven items was standardized to a mean of zero and a variance of one to give each equal weight. For the females, the seven standardized items were averaged to form the index; for the males, each of the five relevant standardized items was averaged to form the index. We should note that the HHANES did not examine use of health services over time; thus recency of use of the aforementioned services was the best indicator of regularity of use.

Acculturation— This construct was assessed with eight items pertaining to spoken and written language and to ethnic identification. The items represent a subset of the 20-item "Acculturation Rating Scale for Mexican Americans" developed by Cuellar, *et al.*[29]

1. What language do you speak?
2. What language do you prefer?
3. What language do you read better?
4. What language do you write better?

These four language measures, as well as the four ethnic measures below, were coded so that higher scores reflected a stronger English language/American orientation. Items 1–4 ranged from "Spanish only" [1], to the midpoint "Spanish

TABLE 1—Sample Characteristics

	Mexican Americans		Cuban Americans		Puerto Ricans	
Age range (years)	20–74		20–74		20–74	
Total sample (20–74)	3326		865		1220	
Analytic sample	2975		794		1138	
Men	1318		351		418	
Women	1657		443		720	
Marital Status	*M*	*F*	*M*	*F*	*M*	*F*
% Married– spouse in home	76.0	65.5	74.8	65.2	61.8	38.6
% Married—spouse not home	2.0	1.9	1.5	1.6	2.5	4.9
% Widowed	1.1	6.4	0.4	7.8	0.3	5.6
% Divorced	3.7	7.6	7.4	11.9	7.0	13.1
% Separated	1.7	6.5	1.5	3.0	4.3	13.8
% Never married	15.5	12.1	14.4	10.5	24.1	24.0
Age (years)						
% 20–30	41.6	39.4	23.2	20.8	34.5	35.8
% 31–40	28.0	26.0	17.2	22.6	26.6	27.5
% 41–50	13.1	14.0	22.7	22.3	18.1	19.1
% 51–74	17.3	20.6	36.9	34.3	20.8	17.6
Annual Family Income						
% Less than $10,000	23.3	33.9	20.7	29.5	29.5	45.0
% $10,000–$19,999	37.6	33.7	33.4	29.7	34.6	29.4
% $20,000–$29,999	21.2	18.0	21.9	17.5	17.2	10.3
% $30,000 and above	17.9	14.4	24.0	23.3	18.7	15.3
Education						
% Less than 7 years	28.1	30.9	22.5	22.6	16.7	16.8
% 7–11 years	26.7	28.6	24.7	22.2	36.1	35.9
% 12 years	23.7	24.2	20.7	26.6	28.2	30.1
% 13 or more	21.5	16.3	32.1	28.6	19.0	17.2

The percentages for marital status, age, income, and education were calculated with normalized sample weights (examination weights).

and English equally" [3], to "English only" [5]. The four remaining items measured ethnic identification:

5. What ethnic identification do you use?
6. What ethnic identification does/did your mother use?
7. What ethnic identification does/did your father use?
8. Where was the birthplace of yourself, your mother, your father?

For the Mexican American sample, the response codes for items 5–7 ranged from "Mexican" [1], to "Mexican American" [3], to "Anglo or other" [5]. For the Cuban Americans and Puerto Ricans, responses to items 5–7 had highly restricted variance; almost all of the Cuban Americans (and their parents) identified themselves as "Cuban"; the same situation occurred for the Puerto Ricans. Thus, these items could not be used meaningfully for these two groups. Item 8 was coded to establish generation. The scale ranged from "first generation (respondent born in country of origin)" [1] to "third or higher generation (respondent and both parents born in United States)" [4]. This item could not be used for the Cuban Americans and Puerto Ricans because of restricted variance; 97.3 percent of the Cuban Americans (ages 20–74) and 80 percent of the Puerto Ricans (ages 20–74) were first generation. Thus, for these two samples, only the four language items were used to assess acculturation. For the Mexican Americans, all eight items were used.

We constructed separate indices of acculturation for each respondent. Because we were interested in analyzing the effects of the different dimensions of acculturation and not just acculturation in general, we performed a factor analysis with the Mexican American data. It suggested that the items could be meaningfully grouped into one of three factors: (a) language preferred and spoken (items 1 and 2); (b) language written and read (items 3 and 4); and (c) ethnic identification (items 5–8). Each Mexican American respondent was assigned a score on each of these three dimensions by first standardizing the items that grouped together on the particular dimension and then averaging the items. Additionally, an overall score was created by averaging all eight items. For the Cuban Americans and Puerto Ricans separately, items 1 and 2 were standardized and then averaged to form a prefer/speak score, and items 3 and 4 were combined in similar fashion to form a read/write score. An overall score for the Cuban Americans and Puerto Ricans was calculated by averaging the four language items.

Access to health care—Five indicators of accessibility of health services were examined.

1. Health insurance, including private as well as public and federal/military assistance (e.g., Medicare, Medicaid, other public assistance, CHAMPUS*, other military programs). Any form of coverage was coded 1; no coverage was coded 0.
2. Whether or not the respondent had a routine place he or she used for health care (yes = 1, no = 0).
3. Type of health care facility used (private clinic, doctor's office, health maintenance organization, or prepaid group [4]; community clinics [3]; hospital outpatient clinic [2]; hospital emergency room [1]). The distribution of response across these categories was somewhat skewed (see Table 3); thus, for the regression analyses categories 3 and 4 were combined and assigned a code of 2, and categories 1 and 2 were combined and assigned a code of 1.
4. Whether or not the respondent usually sees a particular provider at the facility (yes = 1, no = 0).
5. Distance between residence and facility used (less than 10 minutes [3]; between 10 and 20 minutes [2]; over 20 minutes [1]).

An overall access score was constructed by standardizing and then averaging the five measures. In addition, for some analyses the individual measures of access were examined separately.

Data Analysis

All analyses were performed separately for each of the three samples, and separately for men and women applying normalized sample weights (examination weights).[27] We examined the weighted prevalence of preventive behavior and the weighted prevalence of access to services. Associations among variables were examined with weighted Pearson correlations. Our primary analyses of the effects of acculturation and access on recency of utilization were performed with multiple regression. Several regression models were tested, using as predictors the overall acculturation and overall access scores, and in different models using the individual components of these overall scores. Sociodemographic factors (age, education, income) were also included in the equation. Prior to conducting these tests, a statistical program (SESUDAAN)[30] was run to calculate the average design effect for each predictor variable. This average design effect was used to conservatively adjust the standard error of a regression coefficient generated by a weighted ordinary least-squares analysis. We should emphasize that, although certain variables were examined as "predictors," the HHANES is a cross-sectional design; thus, it does not provide evidence regarding cause and effect.

Results

Prevalence of Health Service Utilization

For each sample, recent use of the preventive health services was more prevalent among females than males (Table 2). Further, except for Pap smear and breast examination, recent use was higher among Cuban Americans and Puerto Ricans than among Mexican Americans. For example, less than 50 percent of the Mexican Americans reported that they had a routine physical examination within the last two years, and approximately 20 percent of the Mexican Americans reported that they never had a regular check-up from a physician. A similar pattern occurred for eye and dental examinations; recency of the female examinations was comparable among the samples.

Access to Health Services

The data suggest an association between access to care and utilization of health services. As seen in Table 3, a greater percentage of women than men reported that they had a routine place for health care and that they usually saw a particular provider at the facility. This gender difference in access parallels the gender differences in utilization described above. Second, fewer Mexican Americans (compared to the other two groups) had some form of health insurance coverage (Table 3) which may partially explain their low rate of screening. Finally, consistent with prior research,[31] a substantially larger percentage of Puerto Ricans compared to

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*Civilian Health and Medical Program of the Uniformed Services.

TABLE 2—Weighted Prevalence of Utilization of Services

	Mexican Americans		Cuban Americans		Puerto Ricans	
	Male	Female	Male	Female	Male	Female
Last routine physical						
Less than 2 years ago	33.1	45.4	42.8	59.5	47.3	61.6
Over 2 years ago	46.4	23.8	45.2	31.6	45.3	32.7
Never	20.5	20.8	12.0	8.9	7.4	5.7
Made appointment for visit						
Yes	59.7	71.7	62.8	75.3	45.4	59.4
Last blood pressure taken						
Less than 1 year ago	57.7	78.9	77.7	81.3	72.8	85.0
Over 1 year ago	36.4	19.9	20.3	18.1	25.4	14.6
Never	5.9	1.2	2.0	0.6	1.8	0.4
Last eye examination						
Less than 2 years ago	51.3	51.2	63.5	63.6	62.7	66.1
Over 2 years ago	36.3	38.2	31.8	31.0	31.0	29.7
Never	12.3	10.6	4.7	5.4	6.3	4.2
Last dental check-up						
Less than 2 years ago	49.7	60.0	62.7	72.1	60.8	74.8
Over 2 years ago	39.0	34.0	36.2	27.7	37.0	24.6
Never	11.3	6.0	1.1	0.2	2.2	0.6
Last PAP smear						
Less than 2 years ago		75.3		68.2		79.6
2-5 years ago		9.3		14.0		7.1
Over 5 years or never		15.4		17.8		13.3
Last breast examination						
Less than 2 years ago		77.9		73.2		83.0
2-5 years ago		8.0		11.1		7.0
Over 5 years or never		14.1		15.7		10.0

Entries are not age-adjusted.

Mexican Americans and Cuban Americans used hospital outpatient clinics and hospital emergency rooms as their usual source of health care (Table 3).

Access was correlated with sociodemographic factors. For Mexican American and Cuban American men and women, the overall access score correlated positively with education, annual income, and age (r .10 to .25). The correlation between health insurance coverage and income was especially strong (r .24 to .37). A similar pattern of results was found for Puerto Ricans, but the correlations were not as strong.

Regression Analyses

Overall Effects—The first set of multiple regression analyses used the overall acculturation score, the overall access score, and sociodemographic factors (education, income, age) as predictors of the preventive service use index. The predictors were entered into the equation simultaneously; thus, the effect of each variable was assessed after controlling for the effects of each of the other variables in the equation. As seen in Table 4, the R^2 from each analysis indicated that the array of predictors accounted for more

TABLE 3—Access Related Variables (weighted prevalence)

	Mexican Americans		Cuban Americans		Puerto Ricans	
	Male	Female	Male	Female	Male	Female
Health insurance						
Yes	65.9	66.1	72.1	75.3	70.0	82.7
No	34.1	33.9	27.9	24.7	30.0	17.3
Routine place for health care						
Yes	64.9	82.2	60.7	77.9	74.6	83.4
No	35.1	17.8	29.3	22.1	25.4	16.6
Type of facility used						
Doctor's office, Private clinic, HMO/prepaid group	69.2	70.7	71.8	76.9	46.0	55.1
Community clinic	16.7	19.5	15.5	14.5	18.9	18.9
Hospital outpatient clinic	8.9	8.1	7.8	7.5	25.5	22.1
Hospital ER	5.2	1.7	4.9	1.1	9.6	3.9
Particular provider						
Yes	58.0	69.3	59.6	72.3	47.6	64.3
No	42.0	30.7	40.4	27.7	52.4	35.7
Distance from health care facility						
< 10 min	70.6	78.2	69.5	74.6	71.1	73.8
10-20 min	18.2	13.0	19.5	16.5	17.0	17.7
over 20 min	11.2	8.8	11.0	8.9	11.9	8.5

Entries are not age-adjusted.

TABLE 4—Regression Analyses of Acculturation, Access, and Sociodemographics Predicting Preventive Behavior

	Mexican Americans				Cuban Americans				Puerto Ricans			
	Males		Females		Males		Females		Males		Females	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Acculturation[a]	.100	(.033)	.042	(.023)	.121	(.042)	.059	(.043)	.082	(.086)	−.033	(.027)
Access to care[b]	.182	(.032)	.194	(.021)	.323	(.040)	.207	(.039)	.352	(.063)	.289	(.047)
Education	.032	(.005)	.026	(.005)	.018	(.009)	.013	(.008)	.034	(.010)	.018	(.008)
Annual income	.007	(.003)	.008	(.003)	.001	(.004)	.001	(.006)	−.002	(.004)	.005	(.003)
Age	.009	(.001)	.002	(.016)	.006	(.002)	.004	(.002)	.014	(.003)	.004	(.002)
	R^2 = .212		R^2 = .161		R^2 = .262		R^2 = .104		R^2 = .239		R^2 = .142	

Entries are weighted regression coefficients and adjusted standard errors in parentheses.
a) Overall acculturation score.
b) Overall access score.

variance in the men's preventive behavior than the women's. With respect to individual effects, access to health services was a uniformly strong predictor in each sample. Acculturation, however, was an important predictor only for Mexican American and Cuban American men. The regression coefficients for the sociodemographic variables were small, but the pattern indicated that increased education, increased income, and older age were associated with greater recency in utilization of the health services.

Specific Effects of Acculturation—Additional regression analyses were performed to examine the effects of the individual components of the overall acculturation score (spoken language, written language, and ethnic identification). Because these three components were moderately to highly correlated (*r* .53 to .81), analyzing the three together in a simultaneous model could generate misleading results due to the multicollinearity among the variables. Thus, in addition to testing a simultaneous model, we tested three additional models in which the acculturation measures were analyzed separately. The effects of ethnic identification could be examined only for the Mexican Americans. All of the analyses controlled for age, income, and education.

As seen in Table 5, for Mexican American men and women, Model 1 (all three acculturation variables analyzed together) indicated that only spoken language was significant. That is, preferring to speak English was associated with greater recency in utilization of the services. Models 2, 3, and 4 (which analyzed the three acculturation variables separately) yielded results consistent with the first model. Although spoken language (Model 2) and written language (Model 3) each were predictors, spoken language was the stronger predictor. Ethnic identification was not a predictor in either the simultaneous or individual model (Model 4).

The findings for Cuban Americans and Puerto Ricans were not as clear. For Cuban American men, written language produced stronger effects than spoken language, and neither language dimension produced appreciable effects for Cuban American women or for Puerto Rican men and women.

Specific Effects of Access—Not surprisingly, some of the access variables were correlated. For each sample, having a particular provider was correlated with using HMOs or private clinics (*r* .28 to .48) and with having a routine place for health care (*r* .34 to .60). The correlations among the other access variables were much smaller.

A series of regression analyses were performed that tested simultaneous as well as individual models for the specific access variables. The simultaneous model (Model 1) indicated that, for each sample, having a routine place for health care was generally the strongest predictor of recency in utilization (see Table 6). Comparison of the individual models also reveals that having a routine place for care produced the strongest effects (Model 3). The findings for health insurance were strong in both the simultaneous and the individual model (Model 2), and having a particular provider was a predictor in the individual model (Model 5). The results for the other measures of access were less consistent. Type of health care facility used most often was a predictor only for the men of each sample and only when this variable was the sole access variable in the equation (Model 4). Finally, distance from facility was predictive of utilization only for Puerto Ricans (Model 6); as distance decreased, recency of screening increased.

Discussion

Our analyses unveiled interesting differences in preventive service-related behaviors among the three Hispanic groups. Mexican Americans used such services less recently than the other two groups, except in the case of female examinations. Previous research has also shown that Mexican Americans are less likely than non-Hispanic Whites and Blacks to visit a physician or a dentist, or to be admitted to a hospital.[32] In part, this can be explained by the fact that Mexican Americans are less likely than others to have health insurance as demonstrated in the present and other studies.[33]

There are several reasons for the higher prevalence of health insurance coverage among Cuban Americans and Puerto Ricans. Cuban Americans compared to Mexican Americans are more likely to have private insurance coverage as a result of higher incomes and/or greater availability of health insurance as an employee benefit.[33] Puerto Ricans, however, are more likely than Mexican Americans to be covered by Medicaid; they have higher proportions of female-headed households eligible for Medicaid under Aid to Families with Dependent Children and are more likely to reside in states that provide greater optional coverage under Medicaid.[26,33] The higher prevalence of Medicaid coverage among Puerto Ricans may also explain their greater use of public facilities.

At the outset, we offered two hypotheses to explain the use of preventive health services by Mexican Americans, Cuban Americans, and Puerto Ricans; one emphasized the importance of acculturation and the other emphasized access

TABLE 5—Components of Acculturation Predicting Preventive Behavior

	Males				Females			
Models:	1	2	3	4	1	2	3	4
Mexican Americans								
Spoken language	.116 (.028)	.139 (.022)	—	—	.105 (.023)	.087 (.016)	—	—
Written language	.042 (.032)	—	.104 (.037)	—	−.027 (.024)	—	.047 (.016)	—
Ethnic ID	−.010 (.026)	—	—	.059 (.037)	.004 (.047)	—	—	.039 (.042)
Education	.031 (.005)	.033 (.005)	.036 (.005)	.044 (.005)	.023 (.005)	.023 (.005)	.029 (.005)	.032 (.004)
Annual income	.010 (.003)	.009 (.003)	.011 (.003)	.012 (.003)	.012 (.003)	.012 (.003)	.012 (.003)	.013 (.003)
Age	.012 (.002)	.012 (.002)	.012 (.002)	.012 (.002)	.004 (.001)	.004 (.001)	.004 (.001)	.004 (.002)
Cuban Americans								
Spoken language	−.021 (.051)	.081 (.037)	—		.018 (.043)	.058 (.033)	—	
Written language	.152 (.052)	—	.137 (.038)		.060 (.087)	—	.072 (.078)	
Education	.024 (.009)	.031 (.009)	.023 (.009)		.012 (.008)	.015 (.008)	.013 (.008)	
Annual income	.007 (.007)	.009 (.007)	.007 (.006)		.004 (.007)	.004 (.008)	.004 (.007)	
Age	.012 (.004)	.010 (.003)	.012 (.004)		.006 (.003)	.005 (.002)	.006 (.003)	
Puerto Ricans								
Spoken language	.063 (.079)	.046 (.092)	—		.045 (.061)	−.011 (.025)	—	
Written language	.011 (.100)	—	.053 (.081)		−.076 (.079)	—	−.042 (.025)	
Education	.043 (.011)	.038 (.010)	.044 (.011)		.022 (.008)	.018 (.007)	.024 (.008)	
Annual income	.003 (.005)	.003 (.005)	.004 (.005)		.007 (.003)	.006 (.003)	.008 (.003)	
Age	.019 (.003)	.018 (.003)	.019 (.003)		.007 (.002)	.007 (.002)	.007 (.002)	

Entries are weighted regression coefficients and adjusted standard errors in parentheses. Variables not entered into a specific regression model are indicated by a dash (—). Ethnic identification was not examined for Cuban Americans or Puerto Ricans.

to services. Our findings clearly demonstrated that access was strongly related to utilization. In particular, having a routine place for care and having health insurance coverage produced the strongest effects. With respect to acculturation, language but not ethnic identification was the important predictor of utilization for the Mexican Americans. Language was related to utilization for the Cuban American men but not for the Cuban American women or Puerto Ricans. We are uncertain why the language effect was not found among these latter Hispanic subgroups. In the case of the Puerto Ricans, the public health facilities they tend to use (because of their high rate of Medicaid coverage) may have more Spanish-speaking providers than private clinics and hospitals so that use of the English language may not be essential to access.

Despite the differential effect of language among the three Hispanic groups, language was clearly associated with recency of screening. A prior study obtained similar results.[15] Of four dimensions of acculturation (language, country of origin, contact with homeland, parental expectations of children) only language was significantly associated with use of screening examinations (e.g., physician breast examination, breast self-examination). Further, as discussed earlier, several studies have found that service utilization rates were higher among non-Hispanic Whites than Hispanics after controlling for sociodemographic factors and health insurance coverage.[3–5,11] Although this difference has been attributed to cultural factors in the broad sense, the present data suggest that the results were probably due to specific language differences between the groups [illegible]

What interpretation should be [illegible] this language effect? Traditionally, the effect of [illegible] been viewed as an indicator of the importance of [illegible] in health service utilization. If cultural factors [illegible] one would expect to find strong effects of [illegible] as significant effects of the psychological and [illegible]nsions of acculturation. These latter dimensions, however, have not been shown to be associated with screening behavior. This causes us to question the usefulness of a broad cultural interpretation of the language effect. Our preferred view is that language represents an access factor. Although language preference can be viewed as a measure of cultural integration, it also can be seen as an indicator of functional integration.[34] From this latter perspective, ability to speak English increases the extent to which Hispanics can effectively attain institutional access. This view is consistent with several prior papers that have discussed language as a potential barrier to health service delivery.[7–9] In sum, regardless of one's level of acculturation on psychological or social dimensions, variation in language preference seems to be a critical determinant of utilization of health services, and is best viewed in terms of accessibility.

Recommendations

The present results support several ideas discussed in the literature for increasing the use of health services by

TABLE 6—Components of Access to Care Predicting Preventive Behavior

	Males						Females					
Models:	1	2	3	4	5	6	1	2	3	4	5	6
Mexican Americans												
Health insurance	.068 (.024)	.204 (.049)	—	—	—	—	.116 (.036)	.160 (.034)	—	—	—	—
Routine place for health care	.085 (.047)	—	.290 (.108)	—	—	—	.298 (.079)	—	.357 (.034)	—	—	—
Type of facility used	.166 (.100)	—	—	.216 (.048)	—	—	−.022 (.042)	—	—	.050 (.042)	—	—
Particular provider	.010 (.024)	—	—	—	.210 (.078)	—	.007 (.036)	—	—	—	.164 (.045)	—
Distance to facility	−.023 (.019)	—	—	—	—	.051 (.043)	.024 (.042)	—	—	—	—	.143 (.020)
Education	.038 (.004)	.046 (.004)	.044 (.004)	.044 (.004)	.045 (.004)	.049 (.004)	.031 (.004)	.033 (.003)	.033 (.004)	.034 (.004)	.033 (.004)	.034 (.003)
Annual income	.007 (.003)	.007 (.003)	.010 (.002)	.011 (.002)	.010 (.003)	.012 (.003)	.008 (.002)	.010 (.003)	.010 (.003)	.013 (.002)	.011 (.003)	.012 (.003)
Age	.008 (.002)	.011 (.002)	.010 (.001)	.011 (.002)	.011 (.002)	.012 (.002)	.002 (.002)	.003 (.002)	.003 (.002)	.004 (.001)	.003 (.002)	.004 (.002)
Cuban Americans												
Health insurance	.217 (.067)	.322 (.091)	—	—	—	—	.133 (.152)	.172 (.125)	—	—	—	—
Routine place for health care	.419 (.083)	—	.537 (.058)	—	—	—	.263 (.085)	—	.301 (.057)	—	—	—
Type of facility used	.121 (.088)	—	—	.252 (.089)	—	—	.013 (.150)	—	—	.116 (.148)	—	—
Particular provider	.047 (.102)	—	—	—	.358 (.120)	—	.142 (.063)	—	—	—	.258 (.053)	—
Distance to facility	−.052 (.070)	—	—	—	—	.129 (.083)	−.089 (.047)	—	—	—	—	.061 (.043)
Education	.029 (.008)	.034 (.008)	.033 (.008)	.035 (.008)	.036 (.008)	.038 (.008)	.018 (.007)	.020 (.007)	.022 (.007)	.020 (.007)	.020 (.007)	.021 (.007)
Annual income	.001 (.004)	.005 (.006)	.006 (.004)	.008 (.005)	.006 (.007)	.009 (.007)	.001 (.006)	.002 (.008)	.005 (.008)	.005 (.007)	.002 (.006)	.006 (.008)
Age	.001 (.002)	.006 (.002)	.003 (.002)	.007 (.002)	.006 (.002)	.008 (.003)	.001 (.002)	.003 (.002)	.004 (.002)	.004 (.002)	.003 (.002)	.005 (.002)

Hispanics. Because our data indicate that Mexican Americans are the least likely of the three Hispanic groups to be recent users of preventive services, the following recommendations are particularly relevant to them.

- First, special outreach efforts need to be conducted with Hispanics who are monolingual Spanish or prefer to speak Spanish regarding the importance of medical screening for prevention of illness. Programs directed toward medical providers regarding language issues, increasing bilingual staff, and programs dealing with patient-provider interaction would also be beneficial.
- Second, the present data showed that those with a regular source of care and a particular provider (e.g., family doctor, private clinic, prepaid group) were most likely to use preventive services. Because large portions of Hispanics do not have a regular provider, it would seem important either to: (a) incorporate screening programs into the settings that are used by them, or (b) establish effective referral mechanisms to direct individuals to screening centers.
- Finally, lack of health insurance is a barrier to the use of preventive services, particularly among Mexican Americans. This suggests the need to: 1) increase the availability of low-cost or no-cost medical screening programs in low income Hispanic communities; 2) increase the availability of health insurance coverage as an employee benefit; 3) broaden the eligibility criteria for Medicaid (which in many states is re-

TABLE 6—Continued

	Males						Females					
Models:	1	2	3	4	5	6	1	2	3	4	5	6
Puerto Ricans												
Health insurance	.295 (.138)	.346 (.133)	—	—	—	—	.174 (.109)	.251 (.079)	—	—	—	—
Routine place for health care	.496 (.086)	—	.520 (.114)	—	—	—	.306 (.065)	—	.387 (.050)	—	—	—
Type of facility used	.165 (.089)	—	—	.163 (.076)	—	—	.053 (.115)	—	—	.127 (.077)	—	—
Particular provider	.023 (.069)	—	—	—	.257 (.104)	—	.112 (.047)	—	—	—	.243 (.051)	—
Distance to facility	−.044 (.050)	—	—	—	—	.132 (.055)	.002 (.053)	—	—	—	—	.134 (.063)
Education	.036 (.009)	.041 (.010)	.040 (.009)	.036 (.010)	.041 (.010)	.042 (.010)	.015 (.006)	.017 (.007)	.015 (.006)	.017 (.007)	.015 (.007)	.018 (.007)
Annual income	−.001 (.004)	.001 (.005)	.005 (.004)	.003 (.005)	.003 (.005)	.004 (.004)	.005 (.003)	.006 (.003)	.007 (.003)	.005 (.003)	.004 (.003)	.005 (.003)
Age	.011 (.002)	.015 (.003)	.014 (.002)	.016 (.003)	.016 (.002)	.017 (.003)	.005 (.002)	.007 (.002)	.005 (.002)	.007 (.002)	.006 (.002)	.007 (.002)

Entries are weighted regression coefficients and adjusted standard errors in parentheses. Variables not entered into a specific regression model are indicated by a dash (—).

stricted to single-parent families); and 4) set satisfactory remuneration rates for health care facilities that give uncompensated care to the working poor.[26]

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III. Health Risk Behaviors of Hispanics in the United States: Findings from HHANES, 1982–84

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Abstract: With data from the Hispanic Health and Nutrition Examination Survey (HHANES), we examined several health risk behaviors (cigarette smoking, alcohol use, dietary practices, and recency of health screening) of Mexican American, Cuban American, and Puerto Rican adults (ages 20–74). For each sample, a greater percentage of men than women smoked cigarettes and used alcohol. Heavy smoking (20+ cigarettes per day) was most prevalent for Cuban American males, and heavy drinking (1.00+ oz ethanol per day) was most prevalent for Mexican American and Puerto Rican men. Acculturation correlated positively with alcohol use (particularly for females) and negatively with dietary balance (for Mexican American men and women). The Puerto Ricans' diet was less balanced than that of the other two groups. For each sample, more men than women had not had a routine physical or dental examination within the past five years; the recency of screening was lowest for Mexican American men. Screening (including Pap smear for the women) was lower for those who smoked cigarettes and for those with poor dietary practices, indicating that many Hispanics at special risk of disease underutilize preventive health services, increasing the likelihood of diagnosis at a later stage of illness. [*Am J Public Health* 1990; 80(Suppl):20–26.]

Introduction

Compared to non-Hispanic Whites in the United States, Mexican Americans underutilize preventive health services such as routine physical check-ups, dental and eye examinations, and prenatal care.[1–5] When they present with an illness, the illness frequently is at a later stage.[6,7] Consequently, Mexican Americans are at greater risk of morbidity and mortality than the general United States population.[8]

The screening behavior of persons of Mexican heritage has been shown to be affected by: *access to care*, such as having a regular family physician and health insurance coverage;[2,3,5,9] *cultural variables* such as adaptation to the practices of American society;[5,10–12] and *sociodemographic factors* such as income, education, age, and gender.[13,14] The extent to which utilization of preventive health services is influenced by attitudinal and behavioral factors, however, has received much less attention.

Attitudes about health are reflected in many behaviors. For example, those who smoke cigarettes heavily,[15–17] drink alcohol excessively,[18,19] or maintain an unbalanced and unvaried diet (e.g., high in fried meats and low in fruits, vegetables, and fiber[17,20,21]) place themselves at increased risk of specific diseases, such as cancer of the lungs, pancreas, colorectal area, and prostate,[17,20–25] and hypertension and coronary heart disease.[26,27] Ideally, individuals who engage in these "health risk-behaviors" should use screening services regularly in order to monitor their health status. We suspect, however, that (after controlling for income, education, age, and acculturation) they use those services *less* frequently than individuals who do not engage in such behaviors, based on the assumption that such behaviors are components of a constellation that emanates from a general attitude toward health promotion and disease prevention.[28] This cluster of behaviors is likely to contribute to the presence of illness and to diagnosis at a later stage.

We provide data on the prevalence of these health risk behaviors among Mexican American, Cuban American, and Puerto Rican adults, and examine the extent to which recency of screening (physical and dental examination, Pap smear) is correlated with them.

Methods

Sample

The study used data from the Hispanic Health and Nutrition Examination Survey (HHANES), conducted by the National Center for Health Statistics (NCHS) from 1982–1984. This survey sampled Mexican Americans from five southwestern states, Cuban Americans from Dade County (Miami) Florida, and Puerto Ricans from the New York City area. For detailed information about the complex sampling design see the methodological paper by Delgado, *et al*,[29] at the beginning of this supplement and the NCHS plan and operation of HHANES.[30]

Our analyses focused on adults (20–74 years of age) from each of these three samples. Table 1 presents the total sample sizes in this age range, the analytic sample sizes, and selected sample characteristics. Analyses were restricted to eligible Hispanic sample persons who provided data on each variable used in this study. Of the total number of Mexican Americans, Cuban Americans, and Puerto Ricans (20–74) sampled, 85 percent, 86 percent, and 87 percent, respectively, were included in the analytic samples.

Measures

Health Service Utilization—Recency of physical examination was measured by asking "How long has it been since you had a *routine* physical examination, that is, not for a particular illness, but for a general check up?" Responses were coded on a 5-point scale ranging from "never" [1] to "less than one year ago" [5]. Recency of dental examination was assessed by asking how long it was since they saw a dentist or dental hygienist for dental care (coded from "never" [1] to "six months ago or less" [6]). Recency of Pap smear was examined for the women ("never" [1] to "less than one year ago" [7]).

Cigarette Smoking—This behavior was measured two ways: (a) a dichotomous measure reflected whether or not the respondent was a current cigarette smoker (current smoker = 1; does not currently smoke cigarettes, cigars, or pipes = 0; the few persons who smoked cigars or pipes only were not included in the analyses); or (b) among current cigarette smokers, each was assigned a score indicating the number of cigarettes smoked per day. These two measures allowed us to examine whether the effects of smoking are due to mere

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NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

TABLE 1—Sample Characteristics

	Mexican Americans		Cuban Americans		Puerto Ricans	
Age range (years)	20–74		20–74		20–74	
Total sample (20–74)	3326		865		1220	
Analytic sample size	2824		745		1066	
Men	1249		330		389	
Women	1575		415		677	
	M	**F**	**M**	**F**	**M**	**F**
Marital Status						
% Married—spouse in home	76.5	65.8	74.6	65.6	60.5	39.0
% Married—spouse not home	2.0	1.9	1.3	1.6	2.8	5.1
% Widowed	1.1	6.3	0.5	7.8	0.3	5.8
% Divorced	3.7	7.5	7.8	12.0	7.5	13.4
% Separated	1.8	6.4	1.6	3.1	4.4	14.3
% Never married	14.9	12.1	14.2	10.0	24.5	22.4
Age (years)						
% 20–30	41.4	39.5	23.6	20.1	35.0	34.6
% 31–40	28.0	25.9	17.6	22.9	27.6	27.9
% 41–50	13.3	14.1	23.5	22.9	16.3	19.6
% 51–74	17.3	20.5	35.3	34.1	21.1	17.9
Annual Family Income						
% Less than $10,000	23.1	33.6	20.6	29.0	29.2	44.6
% $10,000–$19,999	37.9	33.7	33.4	30.3	34.8	29.0
% $20,000–$29,999	21.1	18.1	22.6	17.7	17.4	10.9
% $30,000 and above	17.9	14.6	23.4	23.0	18.6	15.5
Education						
% Less than 7 years	27.9	30.9	22.2	22.6	16.3	16.4
% 7–11 years	26.6	28.5	24.9	21.9	36.1	35.9
% 12 years	24.1	24.2	21.3	27.2	28.4	30.1
% 13 or more	21.4	16.5	31.6	28.3	19.2	17.6

The percentages for marital status, age, income, and education were calculated with normalized sample weights (examination weights).

smoking status (smoker vs nonsmoker) or to magnitude of smoking among current smokers.

Alcohol Use—Alcohol consumption was grouped into four volume levels: (a) little or no current use (fewer than 12 drinks of beer, wine, or liquor in one's entire life or in any one year, or no current use); (b) light regular/occasional drinkers (light regular drinkers consumed an average of 0.01 to 0.21 oz of ethanol per day, occasional drinkers drank in the light ethanol range or above but did so irregularly); (c) moderate regular drinkers (an average of 0.22 to 0.99 oz of ethanol per day); and (d) heavy regular drinkers (an average of 1.00 or more oz of ethanol per day). The ethanol scale was constructed by NCHS using a conversion factor in which one oz of beer contains 0.04 oz of ethanol, one oz of wine contains 0.15 oz of ethanol, and one oz of hard liquor contains 0.45 oz of ethanol.

Diet Index—Diet was assessed with a food item and consumption frequency checklist similar to that used by others.[17,20,22,23] Respondents reported on all food items consumed in the past three months. They indicated whether they had eaten the food item daily (coded as a score of 3), weekly (2), less than once a week (1), or never (0). We constructed an overall diet index that consisted of two components. One component was the extent to which an individual's diet was balanced. Specific food items were grouped into dairy products, meats (including poultry and fish), fruits, vegetables, and grains/cereals. For each person, scores were averaged separately for each food group, and then the five subscale scores were averaged. Higher overall scores indicated a more balanced diet (i.e., frequent consumption of foods in each group). The second component consisted of a "junk food" factor, i.e., the extent to which an individual consumed items such as candy, sodas (excluding diet soda), cake, cookies, chips, sugar, etc. The overall diet index was formed by splitting the distribution of scores for dietary balance and the distribution of scores for "junk food" at their respective medians. Those high on dietary balance and low on "junk food" intake were assigned a score of 3; those high on each dimension received a score of 2; those low on each dimension received a score of 1; and those low on balance and high on "junk food" were assigned a score of 0. This index was used in the correlations and regression analyses. For descriptive purposes, we calculated the number of the five food groups from which respondents had eaten one or more food items daily, and the percentage who had eaten one or more "junk food" items daily.

Acculturation—This variable was measured with eight items pertaining to spoken and written language and to ethnic identification. The items represent a subset of the 20-item "Acculturation Rating Scale for Mexican Americans" developed by Cuellar, *et al.*[31]

1. What language do you speak?
2. What language do you prefer?
3. What language do you read better?
4. What language do you write better?

These four measures (as well as the four below) were coded so that higher scores reflected a stronger English language/American orientation. Items 1–4 ranged from "Spanish only" (1), to the midpoint "Spanish and English equally" (3), to "English only" (5). The four remaining items measured ethnic identification:

5. What ethnic identification do you use?
6. What ethnic identification does/did your mother use?
7. What ethnic identification does/did your father use?
8. Where was the birthplace of yourself, your mother, your father?

For the Mexican American sample, the response codes for items 5–7 ranged from "Mexican" (1), to "Mexican American" (3), to "Anglo or other" (5). For the Cuban Americans and Puerto Ricans, responses to items 5–7 had highly restricted variance; almost all of the Cuban Americans (and their parents) identified themselves as "Cuban"; the same situation occurred for the Puerto Ricans. Thus, these items could not be used meaningfully for these two groups. Item 8 was coded to establish generation. The scale ranged from "first generation (respondent born in country of origin)" (1) to "third or higher generation (respondent and both parents born in US)" (4). This item could not be used for the Cuban Americans and Puerto Ricans again because of restricted variance; 97.5 percent of the Cuban Americans (age 20–74) and 80.5 percent of the Puerto Ricans (age 20–74) were first generation. Thus, for these two samples, only the four language items were used to assess acculturation. These four items were standardized to a mean of zero and variance of one (to give each item equal weight) and then averaged to create a composite score for the Cuban Americans and Puerto Ricans. For the Mexican Americans, all eight items were standardized and then averaged to create the acculturation score. Demographic information on annual income, education, and age was also included in the analyses.

Data Analysis

Analyses were performed separately for each of the three samples, and separately for men and women applying normalized sample weights (examination weights).[29] We analyzed the weighted prevalence of each health risk behavior as well as the weighted Pearson correlation of these behaviors with acculturation, education, income, and age. Our primary hypothesis was examined with multiple regression analysis. The regression model for each dependent measure (i.e., utilization variable) included as predictors the three health risk behaviors, acculturation, and the three sociodemographic variables. The predictors were entered into the equation simultaneously. Prior to conducting these tests, a statistical program (SESUDAAN)[32] was run to calculate the average design effect for each predictor variable. This average design effect was used to conservatively adjust the standard error of a regression coefficient generated by a weighted ordinary least-squares analysis. We should emphasize that although certain variables were examined as "predictors," the HHANES is a cross-sectional design; thus, it does not provide evidence regarding cause and effect.

Results

Prevalence of Health Risk Behaviors

For each sample, behaviors that increase one's risk of illness and disease were more prevalent for men than women. A greater percentage of the men smoked cigarettes and drank alcohol heavily (Table 2). Heavy cigarette smoking was most prevalent for Cuban American men, and heavy drinking most prevalent for Mexican American and Puerto Rican males. Dietary balance was somewhat lower for men than women, and lower for the Puerto Ricans compared to the other two groups. Further, for each sample, more men than women had not had a physical or dental examination within the last five years. These gender differences occurred for those above, as well as for those below, the median on the acculturation index. The utilization of the health services was especially low for the Mexican American men. Table 2 also indicates that use of the preventive services was lower for the Mexican Americans than the Cuban Americans and Puerto Ricans. One explanation for this difference is that fewer Mexican Americans had some form of health insurance coverage.[5]

Correlation of Health Risk Behaviors with Acculturation and Sociodemographics

With only a few exceptions, the pattern of the correlations was similar for men and women, and for each sample (Table 3). Because of the relatively large sample sizes, many of the coefficients were statistically significant even though their absolute magnitudes were low. There were, however, several meaningful effects. The strongest associations involved acculturation, which correlated with increased alcohol consumption (particularly for the women of each sample), and with lower diet scores for the Mexican American men and women. As age increased, alcohol consumption decreased; the correlations between age and cigarette smoking and between age and diet were small. Those with more

TABLE 2—Weighted Prevalence of Health Risk Behaviors

	Mexican Americans		Cuban Americans		Puerto Ricans	
	Males	Females	Males	Females	Males	Females
Percent current cigarette smoker	43.9	24.2	45.1	23.9	41.9	33.5
Percent smoking 20+ cigarettes per day	13.7	4.5	27.3	11.9	22.0	12.2
Percent current alcohol user	77.4	34.7	68.9	22.8	70.8	32.6
Percent drinking 1.00+ oz ethanol per day	17.1	1.2*	9.2	0.4*	17.1	2.5*
Dietary balance[a]						
0–1	22.4	16.9	14.8	13.0	29.0	30.3
2–3	50.9	51.0	57.3	52.1	50.1	49.5
4–5	26.7	32.1	27.9	34.9	20.9	20.2
"Junk food" intake[b]	67.4	61.0	75.3	75.7	79.1	73.9
Percent having last physical examination over 5 years ago or never	46.1	37.5	33.0	22.7	31.8	19.4
Percent having last dental examination over 5 years ago or never	29.9	21.7	16.5	9.6	19.1	9.5
Percent having last Pap smear over 5 years ago or never		15.4		17.8		13.3

Entries are not age-adjusted.

*An asterisk next to an entry indicates that the statistic should be viewed cautiously because it does not meet the minimum reliability standard due to small cell size.

[a] The scale for dietary balance indicates the number of healthy food groups from which the person had eaten one or more food items daily.

[b] The entries for "junk food" indicate the percentage who had eaten one or more "junk food" items daily.

TABLE 3—Correlation of Health Risk Behaviors with Acculturation and Sociodemographics

	Age		Education		Income		Acculturation	
	M	F	M	F	M	F	M	F
Mexican Americans								
Smoking	.01	.01	−.12	−.01	−.17	−.07	−.06	.09
Alcohol use	−.11	−.13	.12	.29	.10	.10	.11	.30
Diet index	.04	.08	.06	.03	.06	.05	−.12	−.12
Cuban Americans								
Smoking	−.10	−.11	−.04	.03	.04	−.05	−.15	−.01
Alcohol use	−.18	−.29	.10	.30	.13	.21	.13	.36
Diet index	−.01	.10	.08	.12	.05	.06	.04	.03
Puerto Ricans								
Smoking	−.06	−.13	−.13	.01	−.18	−.06	−.07	.17
Alcohol use	−.13	−.17	.05	.25	−.01	.12	.04	.26
Diet index	.03	.16	.07	.15	.11	.13	.06	−.03

Entries are weighted Pearson correlations. Cigarette smoking was a dichotomous variable with current smoker = 1 and nonsmoker = 0.

education and higher income (especially the women) consumed a greater volume of alcohol.

Correlates of Screening

Smoking—In separate regression analyses the two cigarette smoking measures were examined as predictors of recency of screening. Only the dichotomous measure was significant, which suggests that the key factor associated with screening activity was whether or not one smokes, not necessarily the amount one smokes. As seen in Table 4, among the Mexican Americans and Cuban Americans, smokers were less recent users of the health services than were the nonsmokers. These effects are seen more concretely in Table 5, which presents the weighted prevalence of recent utilization by smoking status (not controlling for other factors). The findings were strongest for the Mexican American and Cuban American men; for these two groups, the results were consistent across levels of acculturation. The relation between smoking and screening for the Puerto Rican men and women was generally in the predicted direction, although very weak.

Diet—Dietary practices were associated with screening, especially for the Mexican American women. Among this subgroup, those with poorer diets (i.e., low in balance and high in "junk food" intake) were less recent users of the health services (Tables 4 and 5). This association was not qualified by the degree of acculturation of the Mexican American women.

An interesting pattern emerged for the diet and smoking variables for the Mexican American sample. Whereas the

TABLE 4—Regression Analyses of Health Risk Behaviors, Acculturation, and Sociodemographics Predicting Recency of Screening

	Males				Females					
	Physical Examination		Dental Examination		Physical Examination		Dental Examination		Pap Smear	
	b	SE	b	SE	b	SE	b	SE	b	SE
Mexican Americans										
Smoking	−.139	.085	−.354	.103	−.085	.089	−.086	.092	.013	.107
Diet index	.101	.046	.043	.055	.130	.039	.169	.040	.110	.047
Alcohol	−.079	.039	.086	.047	−.050	.090	.119	.091	.108	.106
Acculturation	.244	.084	.117	.103	.119	.098	.011	.101	.166	.118
Education	.050	.020	.061	.025	.041	.023	.085	.023	.038	.027
Income	.015	.003	.031	.007	.013	.006	.029	.007	.025	.007
Age	.014	.004	.014	.004	.012	.004	.008	.004	−.011	.004
Cuban Americans										
Smoking	−.275	.158	−.412	.167	−.207	.152	−.107	.155	−.342	.203
Diet index	.087	.072	.075	.076	−.011	.059	.063	.060	.125	.078
Alcohol	.019	.082	.010	.067	−.308	.148	−.134	.148	−.198	.191
Acculturation	.095	.120	.209	.127	.111	.117	.261	.119	.183	.154
Education	.053	.023	.018	.025	.033	.022	.026	.022	.010	.029
Income	.005	.011	.031	.012	−.014	.011	.012	.011	.031	.015
Age	.020	.007	.002	.007	.007	.006	.000	.005	−.014	.008
Puerto Ricans										
Smoking	−.087	.146	−.084	.168	−.056	.132	.043	.148	.218	.178
Diet index	.053	.071	.057	.052	.057	.064	−.012	.072	.138	.087
Alcohol	−.020	.076	−.145	.079	−.073	.096	−.008	.108	−.122	.131
Acculturation	.182	.130	.074	.149	−.086	.149	−.167	.164	−.171	.199
Education	.053	.025	.048	.029	.034	.025	.063	.029	.031	.035
Income	−.006	.013	.016	.015	.001	.016	.010	.018	.015	.022
Age	.022	.009	.006	.010	.007	.004	−.004	.005	.008	.006

Entries are weighted regression coefficients and adjusted standard errors. The health service measures were coded with higher numbers indicating more recent use of the service. Cigarette smoking was a dichotomous variable with current smoker = 1 and nonsmoker = 0.

TABLE 5—Weighted Prevalence of Recent Screening by Health Risk Behaviors

	Males		Females		
Recency:	Physical 0–2 yrs	Dental 0–2 yrs	Physical 0–2 yrs	Dental 0–2 yrs	Pap 0–2 yrs
Mexican Americans					
Cigarette smoking					
Smoker	29.7	42.1	42.3	57.3	75.6
Nonsmoker	37.4	55.9	47.3	62.2	76.0
Diet[a]					
Low	31.0	46.3	42.7	55.0	72.8
High	37.0	53.6	49.3	67.0	79.2
Alcohol use					
Moderate/high	30.8	52.2	45.2*	70.0*	83.0*
None/low	36.7	47.9	46.2	60.3	75.3
Cuban Americans					
Cigarette smoking					
Smoker	34.6	51.8	54.1	70.6	59.4
Nonsmoker	49.8	71.4	60.2	73.6	71.5
Diet					
Low	38.9	59.3	57.3	71.7	66.9
High	46.9	65.8	60.2	74.0	70.4
Alcohol use					
Moderate/high	41.1	60.2	61.4*	70.0*	89.4*
None/low	44.1	64.0	58.7	73.0	67.7
Puerto Ricans					
Cigarette smoking					
Smoker	45.7	59.8	59.0	74.9	80.5
Nonsmoker	49.3	63.5	63.5	74.9	78.8
Diet					
Low	46.6	56.9	55.9	72.9	76.0
High	48.6	66.0	67.6	76.7	82.6
Alcohol use					
Moderate/high	44.9	58.4	54.3*	81.1*	76.5*
None/low	49.9	64.5	62.8	74.3	79.6

Entries are not age-adjusted.

*An asterisk next to an entry indicates that the statistic should be viewed cautiously because it does not meet the minimum reliability standard due to small cell size.

[a] The "low" diet score includes individuals who received a score of 0 or 1 on the overall diet index; the "high" diet score includes persons who received a score of 2 or 3 on the overall diet index.

association between dietary behavior and screening was stronger for the women than the men, the relation between smoking and screening was stronger for the men than the women. These gender-specific associations were not as clear for the Cuban Americans or Puerto Ricans.

Alcohol—The results for alcohol consumption were mixed. Some of the regression coefficients suggested that heavier drinking tended to associate with less recent use of the health services (e.g., Mexican American men/physical examination), while other coefficients suggested the opposite. We attempted to clarify the picture by examining a subset of heavy drinkers who did not suffer from chronic illnesses (diabetes, heart disease, hypertension) that may necessitate regular visits to a physician. Analyses of this subset, however, yielded essentially the same null and mixed results. Second, among those with no chronic illnesses we compared screening rates for two extreme groups: nondrinkers versus heavy drinkers (those drinking an average of 1.00 or more oz of ethanol per day). Again, most of the results were nonsignificant. Thus, the hypothesis regarding the association between heavy drinking and infrequent use of preventive health services was not confirmed.

Acculturation and Sociodemographics—These factors did not produce strong effects. Increased acculturation tended to be associated with greater recency of screening for the Mexican Americans and Cuban Americans. Higher levels of education and higher income (primarily for the Mexican American men and women) were related to more recent use of the services, although the regression weights were small. The effects of age were minimal.

Discussion

Cigarette smoking, poor dietary practices, and excessive alcohol consumption place individuals at risk of specific disease.[20–27] Ideally, those who engage in these health risk behaviors should use preventive health services regularly in order to monitor their health status. The present study demonstrated several instances in which those at risk were screened *less* recently than those not at risk. Such underutilization increases the likelihood of diagnosis of illness at a later stage.

For each sample, risk of disease was greater for men than women. Men were more likely to be smokers, heavier smokers, and heavier alcohol users; also, their screening rates were much lower than the women's. These gender differences held across level of acculturation, which suggests that similar results would be found in non-Hispanic populations.

The gender effects may stem from sex-role norms. The strong emphasis in our society on self-reliance and independence for men may contribute to their less-than-optimal health attitudes and practices.[33] Further, these norms may influence personal beliefs about one's invulnerability to illness,[34] which may be held more strongly by Hispanic men than Hispanic women. Such beliefs are likely to impact negatively on preventive action.[35]

We found significant positive correlations between acculturation and alcohol consumption, especially for the women of each sample. These findings are consistent with the acculturation model of alcohol use,[36–38] which emphasizes normative influence on behavior. The dominant norms guiding alcohol consumption among non-Hispanic women are more liberal than the cultural norms for Hispanic women—non-Hispanic women drink more frequently and drink greater quantities of alcohol than Hispanic women in general.[36] As Hispanic women acculturate, their drinking increases because their behavior becomes more strongly influenced by the norms and practices of the dominant group. The smaller correlation between acculturation and alcohol use for Hispanic men may reflect the fact that, although the specific pattern of frequency versus quantity of alcohol consumed differs somewhat between Hispanic and non-Hispanic males,[36] the drinking norms for these two groups are fairly similar.

Health risk behaviors such as cigarette smoking and poor dietary practices were associated with less recent screening activity. In particular, for the Mexican American and Cuban American men, cigarette smoking correlated strongly with less recent utilization of routine dental and physical examinations; for the women especially the Mexican American women), poor dietary practices correlated strongly with less recent screening, including Pap smear. Because the HHANES was a cross-sectional design, we cannot conclude that cigarette smoking or poor dietary practices causes one to use screening services infrequently. Rather, the data suggest that these behaviors tend to co-occur. At the outset, we suggested that the relationships may stem from a common factor, namely one's underlying attitude toward health promotion and disease prevention. It is also quite possible, however, that some smokers may actively avoid check-ups from doctors because of their anxiety about receiving negative feedback about their health or being told by the physician to quit smoking. Alternatively, some smokers may still be unaware of the link between smoking and disease, or may discount or deny that link, and thus use screening services infrequently.[39] These possibilities are not limited to any one subpopulation. The fact that we found the same inverse association between smoking and utilization for high and low acculturated Mexican American and Cuban American men suggests that our findings would generalize to non-Hispanic White populations. We should note, however, that although the associations may hold for each of these groups, the absolute level of medical screening is lower among Hispanics.[1,3]

Finally, alcohol consumption was not strongly or consistently related to screening in any of the three samples. Unfortunately, the present data do not permit a conclusion regarding the role of this health risk behavior in screening activity. One potentially important factor, however, is a person's perception of the health effects of alcohol use, which is likely to vary considerably among individuals. For example, some people with a relatively positive attitude toward health promotion may drink moderately/heavily due to the fact that they perceive the risk of drinking to be slight. Others may perceive the risk of drinking differently. This variability may occur because, compared to the clear media message about the negative effects of smoking cigarettes, the health consequences of alcohol have not been communicated as clearly or consistently. The variable beliefs about the effects of alcohol use may have contributed to the inconsistent findings for alcohol consumption and medical screening.

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IV. Health Care Utilization Barriers among Mexican Americans: Evidence from HHANES 1982–84

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Abstract: Data from the Hispanic Health and Nutrition Examination Survey (HHANES) conducted by the National Center for Health Statistics in 1982–1984 were analyzed to document the type of barriers encountered which prevented Mexican Americans from obtaining health care, the sociodemographic subgroups most vulnerable to such barriers, and to examine the combined effects of predisposing, enabling, and need characteristics on these barriers.

The findings suggest, in general, that low income groups, younger age groups, the less acculturated, those who lack health insurance coverage, those with functional limitations, and those in poorer perceived health status encounter more barriers than others, and are prevented by these barriers from obtaining health care for themselves. [*Am J Public Health* 1990; 80(Suppl):27–31.]

Introduction

Mexican Americans have been found to make less use of health care than White and Black non-Hispanics, Puerto Ricans, Cuban Americans and other Hispanics.[1,2] Previous research has identified various potential barriers which may impede Mexican Americans from obtaining medical care. These barriers include, but are not limited to, language and cultural differences, lack of transportation, geographic inaccessibility, financial constraints such as the cost of health care and limited health insurance coverage, and isolation from the mainstream culture.[3–9]

Several models have been proposed to examine the utilization of health services.[10–14] One of the most widely used models is a behavioral model developed by Andersen[14] and subsequently expanded by Andersen and Newman,[15] Aday and Andersen,[16] and Andersen, *et al.*[8] In its original formulation Andersen's model conceived of health care utilization as a consequence of three general factors: 1) predisposing characteristics such as age and gender; 2) enabling characteristics such as income and health insurance coverage; and 3) need characteristics such as health status. The components of this model were hypothesized to contribute independently to the understanding of differential utilization of health services. Need characteristics have been found to be more important in predicting utilization of health services than either predisposing or enabling characteristics.[17–19]

Mechanic,[17] Rundall,[18] and Wolinsky[19] have noted several problems with the model in its current form: the low amount of utilization variance explained by the model; the specification of the model in practice as additive, when in fact the model as stated by Andersen and colleagues suggests characteristics, over and above that explained by predisposing and enabling characteristics.

The approach taken in this paper uses a multivariate model based upon Andersen and colleagues' behavioral model of health care utilization.[7,8,14,16] This model focuses on utilization barriers using health care utilization as a control in order to examine variables related to encountering barriers and being prevented by these barriers from obtaining health care.

The over-riding rationale in the model's application to utilization barriers is that if predisposing, enabling, and need characteristics help explain the over- or underutilization of health care, these same constructs may help explain why some people encounter barriers and are thus prevented from utilizing health care services.

The purpose of the present study is three-fold: to document the type of barriers to health care reported by Mexican Americans; to determine which sociodemographic subgroups are most vulnerable to such barriers; and to examine the joint effects of predisposing, enabling, and need characteristics on the barriers to health care.

Methods

In the analyses presented in this paper, sampling weights were employed to arrive at reliable point estimates, and corrections for the clustering effect introduced by the complex sample design were accounted for when means and standard errors were computed by a method developed at the National Center for Health Statistics[20] and documented in this issue of the Journal.[21] The current analyses focus on 3,935 Mexican Americans ages 20–74 years who were eligible for inclusion based on their having self-identified themselves as either Mexican, Mexican American, or Chicano.

In keeping with Andersen's multivariate framework, the present study includes predisposing, enabling, and need characteristics. Table 1 displays each of the variables under these constructs differentiated by gender and age group as well as the percentage of persons who reported encountering barriers and the percentage of persons who reported having had a physician visit within the past year.

Dependent Variables

Persons interviewed in the Hispanic Health and Nutrition Examination Survey (HHANES) were asked if they encountered a barrier when they last attempted to utilize health care (from a list of 13 possible barriers, Table 2). If they reported encountering a barrier, they were further asked if this barrier actually prevented them from receiving health care.

The two major dependent variables of interest therefore were the extent to which respondents encountered utilization barriers and whether or not these barriers prevented them from obtaining care for themselves. Utilization of a physician within the past year was used as a control variable when each of the dependent variables was examined. Barriers which prevented care from being received were dichotomized as "prevented" and "not prevented" from obtaining health care. Utilization barriers encountered is a continuous variable derived by dividing the sum of those barriers the respondent reported encountering by the total possible number of barriers reported. Not all persons could report en-

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NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

TABLE 1—Sociodemographic and Health Utilization Related Variables by Gender and Age Group

Characteristics	Ages 20–30 Male (N = 628)	Ages 20–30 Female (N = 696)	Ages 31–45 Male (N = 553)	Ages 31–45 Female (N = 646)	Ages 46–74 Male (N = 616)	Ages 46–74 Female (N = 796)
Predisposing						
Mean age	24.8	24.9	36.6	36.9	56.9	57.1
Mean Aculturation	2.6	2.7	2.6	2.6	2.4	2.3
% Married	60.1	65.2	85.9	73.9	84.5	63.8
% US born	59.3	65.7	59.6	62.3	64.4	67.3
Enabling						
Mean income	15.8	15.1	17.5	15.9	15.1	13.4
Mean education	10.6	10.3	9.9	9.5	7.3	6.7
% In poverty	23.7	30.1	19.6	29.6	27.4	36.5
% Employed	92.3	52.4	95.6	54.9	65.8	34.8
% Speak english	61.5	65.3	63.4	64.6	55.6	52.9
% Have regular source of care	55.9	77.6	68.6	82.9	78.1	86.0
Type of Insurance:						
% Not covered	43.8	38.1	29.6	31.6	26.5	33.2
% Private	54.1	53.4	66.9	58.8	47.5	41.3
% Medicare	.3	.8	1.0	1.3	18.0	13.2
% Medicaid	1.3	6.9	.8	6.6	6.2	10.4
% Other public	.4	.9	1.7	1.8	1.8	1.9
Need						
% Impaired	43.3	4.4	4.6	8.2	17.6	18.9
Perceived health:						
% Poor	2.1	2.2	2.9	4.0	11.5	15.0
% Fair	22.4	24.5	23.3	32.8	35.4	39.8
% Good	37.0	38.9	36.4	32.9	31.6	28.8
% Very good	20.2	18.9	21.1	17.7	13.9	10.4
% Excellent	18.2	15.5	16.3	12.6	7.6	6.0
Outcome						
Mean % barriers	7.0	8.8	5.4	7.4	4.2	7.5
% Last physician visit <1 year ago	51.0	80.0	56.8	72.2	63.2	76.7

TABLE 2—Rank Order of Specific Barrier Items, Mexican Americans (N = 3935)

Barriers Encountered Which Impeded Care	Persons Reported Encountering Barrier(s) N	Persons Reported Encountering Barrier(s) %	Persons Encountered Barrier(s) Reported Care Prevented* %
Cost of health care	706	18.0	82.3
Had to wait too long in the office or clinic	376	9.5	58.9
Had to wait too long to get an appointment	365	9.3	67.0
Would lose pay from work (applicable only to those who work)	337	8.6	72.7
The hours were inconvenient	307	7.8	70.3
Care was not available when needed	256	6.5	74.0
Did not know where to go	228	5.8	75.0
Did not have transportation	224	5.7	74.2
Had no confidence in the staff	168	4.3	62.9
Needed someone to take care of your children (applicable only to those with children)	132	4.2	78.3
Staff did not speak Spanish	155	3.9	62.8
Staff was disrespectful	109	2.8	53.2
There were no Hispanic staff members	91	2.3	65.6

*The percent reported for prevented barriers is derived from those persons who acknowledged an encountered barrier. For example, 82.3 percent of those who encountered cost as a barrier said it actually prevented them from obtaining care for themselves.

countering all 13 barriers. Persons who were employed and had children could report all 13 possible barriers. Persons who either were not employed or did not have children could only report 12 possible barriers. Persons who were unemployed and had no children could only legitimately report 11 of the possible 13 barriers on the list.

Results

Sixty-seven percent of the Mexican American sample did not report encountering any barriers while approximately 33 percent of the sample reported encountering one or more barriers when last attempting to obtain health care. Among those who reported encountering barriers to health care, 73 percent reported that the barrier(s) were serious enough to actually prevent them from obtaining health care on that occasion.

The encountered and prevented barrier items were rank-ordered by the percent of respondents who reported each item (Table 2). The five most commonly encountered barriers reflect dimensions of availability and accessibility of health care. For example, cost of health care was the most frequently encountered barrier among Mexican Americans, followed by having to wait too long at the doctor's office or clinic, waiting too long to get an appointment to be seen, inconvenient clinic or office hours, and losing income as a result of having to be away from work to obtain health care.

The five barriers which were most frequently reported as actually preventing Mexican Americans from obtaining health care were somewhat different. While cost of health care was the most frequently reported, needing someone to take care of their children while they obtained health care was the second most cited barrier which prevented them from obtaining health care, followed by not having transportation to get to the source of health care, and losing pay from work while obtaining care.

In general, relatively few Mexican Americans reported encountering barriers which reflect the cultural and linguistic aspects of health care (e.g. no Spanish-speaking staff members, no Hispanic staff members, staff being disrespectful). The data seem to suggest that cost, availability, and accessibility constraints were more important than cultural constraints as measured by the HHANES.

Bivariate Associations

Predisposing Characteristics—The relationships between selected predisposing characteristics and utilization barriers were examined so as to identify sociodemographic subgroups within the Mexican American population who were most vulnerable to encountering barriers to health care. Results revealed that Mexican Americans who are younger in age, female, less acculturated, and foreign born were more likely to be prevented from obtaining health care than others.

Enabling Characteristics—Overall, the enabling characteristics examined showed a consistent and significant association with utilization barriers. Persons with low incomes or low educational levels, Spanish-speakers, those with incomes below the poverty level, the unemployed, the uninsured, and those without a regular source of care reported utilizing health care services less frequently and were more likely to encounter barriers to obtaining health care. These variables were interrelated: e.g. the unemployed have lower incomes and probably have less insurance coverage than the employed. The predisposing and enabling characteristics suggest that a significant proportion of those who can least afford health care and who are least equipped to deal with the American health care system were prevented from using health care services.

Need Characteristics—Both need characteristics examined (perceived health status and functional impairment) were found to be positively associated with encountering barriers and thus being prevented from obtaining health care. Obviously, persons in poor health and those with functional impairments have greater opportunity to encounter barriers to care due to their greater need for care and greater utilization of health services. Nonetheless, Mexican Americans with greater health needs reported encountering more barriers.

Multivariate Analyses

To assess the combined effects of predisposing, enabling, and need characteristics, separate multivariate analyses were performed with utilization barriers encountered and prevented as the dependent variables, respectively, controlling for time since last physician visit. All independent variables were entered simultaneously into each multivariate model. Therefore, the coefficients reported in Tables 3 an 4 estimate the relationship of each independent variable on the dependent variable, while simultaneously taking into account all other independent variables.

The control variable, time since last physician utilization, was dichotomized as "0" meaning less than one year and "1" meaning greater than one year. Barriers which were reported to have prevented a person from obtaining care were dichotomized as "0" meaning no barriers and "1" meaning one or more barriers were reported. Design effects were

TABLE 3—Results of Multiple Regression for Dependent Variable: Percent Barriers Encountered by Age and Gender

	Visited Physician within Last Year				Visited Physician One Year or More Ago			
	Males		Females		Males		Females	
Variables	b	SE	b	SE	b	SE	b	SE
Ages 20 to 30								
Acculturation	.0098	.013	.0033	.008	−.0034	.013	−.0146	.017
Marital status	−.0067	.003	.0023	.003	−.0048	.003	.0037	.007
Income	−.0019	.001	−.0032	.001	.0001	.001	−.0062	.002
Education	.0015	.003	.0004	.003	−.0000	.003	.0024	.007
Have regular source of care	−.0265	.018	−.0439	.018	.0050	.018	−.0258	.004
Type of insurance	−.0166	.019	.0045	.008	−.0058	.021	.0215	.025
Impaired	0200	.053	.0210	.031	.0307	.059	.0007	.085
Perceived health	−.0365	.010	−.0169	.007	−.0165	.010	.0024	.008
Ages 31 to 45								
Acculturation	−.0065	.011	−.0129	.010	.0144	.010	.0105	.014
Marital status	.0117	.006	.0040	.005	.0088	.006	−.0046	.006
Income	−.0014	.001	−.0010	.001	−.0034	.002	−.0034	.002
Education	−.0018	.003	−.0010	.003	.0039	.002	−.0017	.004
Have regular source of care	−.0004	.022	.0240	.024	−.0304	.017	−.0196	.023
Type of insurance	−.0191	.013	−.0055	.009	.0019	.014	.0032	.015
Impaired	.0063	.041	.0068	.025	.0184	.047	−.0186	.069
Perceived health	−.0031	.010	−.0178	.007	−.0196	.010	−.0214	.013
Ages 46 and Older								
Acculturation	−.0044	.007	−.0196	.008	−.0139	.008	.0077	.015
Marital status	−.0062	.005	−.0009	.004	−.0012	.006	.0291	.007
Income	.0009	.009	−.0019	.001	.0003	.001	.0023	.002
Education	−.0036	.002	−.0006	.002	.0005	.002	−.0086	.003
Have regular source of care	−.0407	.019	.0154	.024	.0207	.014	−.0079	.024
Type of insurance	−.0106	.007	−.0222	.006	−.0137	.008	−.0117	.013
Impaired	.0302	.015	.0922	.016	.0215	.027	.0366	.034
Perceived health	−.0052	.006	−.0106	.007	−.0078	.006	−.0206	.014

TABLE 4—Multiple Logistic Regression Coefficients Estimating the Effect of Predisposing, Enabling, and Need Characteristics on Barriers Prevented Care Those Reporting They Visited the Physician within the Last Year (0 to 11 Months) (N = 793)

Variables	Regression Coefficient	S.E.	Odds Ratio	(Confidence Intervals)
Those Reporting Visit to Physician within the Last Year (N = 793)				
Age	−.0076	.008	.98	(.95, 1.02)
Gender (1 = Male, 2 = Female)	.1220	.167	1.32	(.62, 2.81)
Marital status (1 = married, 2 = not married)	−.0595	.043	.87	(.72, 1.06)
Annual income	−.0457	.013	.90	(.85, .95)
Education level	.0083	.027	1.02	(.90, 1.15)
Acculturation level	−.0792	.098	.92	(.45, 1.30)
Perceived health status	−.1462	.082	.71	(.49, 1.03)
Impairments (1 = yes, 2 = no)	.5828	.309	3.82	(.84, 15.43)
Type of insurance	−.1555	.096	.70	(.45, 1.08)
Regular source of care (1 = yes, 2 = no)	−.3400	.235	.46	(.16, 1.32)
Those Reporting Visit to Physician Longer than One Year Ago (N = 304)				
Age	−.0413	.014	.91	(.85, .97)
Gender (1 = Male, 2 = Female)	.5262	.311	3.36	(.83, 13.66)
Marital status (1 = married, 2 = not married)	.1298	.084	1.35	(.92, 1.97)
Annual income	−.0178	.024	.96	(.86, 1.07)
Education level	−.0498	.048	.89	(.88, .90)
Acculturation level	.1014	.173	1.26	(.58, 2.76)
Perceived health status	−.3404	.150	.46	(.23, .90)
Impairments (1 = Yes, 2 = No)	.3500	.663	2.24	(.11, 44.61)
Type of insurance	−.0999	.207	.80	(.31, 2.02)
Regular source of care (1 = yes, 2 = no)	−.1249	.320	1.33	(.31, 5.65)

Original sample size is 1109 because only those who reported encountering a barrier are included. Controlling for visit greater than one year and listwise deletion of missing variables reduces the N to 304.

Standard errors adjusted when design effect >1.

computed using SESUDAAN, which incorporates the Taylor Approximation Method. Standard errors were then adjusted when design effects were greater than one.

Utilization Barriers Encountered as Dependent Variable—Regressions were run separately for each age-gender group using utilization of health services in the past year as a control variable (see Table 3).

Among persons who have visited a physician within the past year, the strongest variable associated with encountering barriers among Mexican American men ages 20–45 years was marital status, with married men encountering more barriers to health care. Among Mexican American men ages 46–74 years, those with less years of formal education, those with no regular source of care, and those with functional impairments encountered more barriers than others. For Mexican American women ages 20–45 years, poorer perceived health status, low income, and not having a regular source of care were associated with encountering barriers when seeking care. Among Mexican American women 46–74 years of age, the less acculturated, the uninsured, and those with functional impairments encountered more barriers than others.

For Mexican American men ages 20–30 years who have not visited a physician for one year or more, lack of health insurance coverage and poorer perceived health status were associated with encountering barriers. There were no associations of consequence for Mexican American men 31 years of age and older. For Mexican American women ages 20–30 years, those with no health insurance coverage and those in poorer perceived health status encountered more barriers than others. Among Mexican American women ages 31–45 years, those with low incomes and those in poorer perceived health status encountered more barriers; for Mexican American women ages 46–74 years, being married and having less years of education were associated with encountering barriers when seeking health care.

Barriers Which Prevented Health Care as Dependent Variable—Multiple logistic regression analysis was the method of choice employed to examine the contributions of the predisposing, enabling, and need variables because of the skewed distribution and dichotomy of the dependent variable. Utilization of health services in the past year was again used as a control variable. Table 4 displays the results of this analysis which included only persons who reported encountering a utilization barrier.

Results indicated that, among Mexican Americans who saw a physician within the past year, those with lower incomes and those with functional impairments were more likely to be prevented from obtaining care than others. Among Mexican Americans who had not visited a physician within the past year, younger persons, women, and those in poorer perceived health status were more likely than others to have been prevented from obtaining health care.

Discussion

Findings from the HHANES revealed that approximately one-third of the adult Mexican American population had reported barriers to obtaining health care during their most recent medical encounter. These barriers to receiving health care were significant in that three-fourths of the time the barriers encountered were sufficient to prevent persons from obtaining the medical care they sought.

Analyses revealed that Mexican Americans with low educational levels and low incomes are experiencing more problems than other Mexican Americans in accessing health care. Spanish-speaking, foreign-born, and less acculturated Mexican Americans were found to be the most likely to be prevented from obtaining the care they sought.

A significant minority of the adult Mexican American population reported encountering barriers which prevented them from accessing medical care. Almost one in five adult

Mexican Americans reported the cost of medical care was a barrier to their receiving care. The concern over the cost of health care among Mexican Americans would appear to be warranted, given that they have the highest rate of being uninsured for medical expenses in the country.[2] A smaller proportion of the adult Mexican American population reported problems accessing medical care due to the lack of health care services during nonworking hours (e.g. losing pay from work, hours of operation were inconvenient, care was not available when needed). Occupational analyses were not performed; however, it may be that access to medical care is more dependent upon the availability of expanded hours of operation among health providers due to the greater propensity of Mexican Americans to be employed in hourly-paid service occupations.

Given the shortage of minority and multilingual health providers in the United States, it was encouraging to find that fewer Mexican Americans reported cultural or linguistic barriers to care (e.g., no Spanish-speaking staff, no Hispanic staff, disrespectful staff). This finding was unexpected given the body of research which has suggested that the exclusion of Spanish-speaking and/or Hispanic staff members is a primary reason for underutilization of health services among Mexican Americans.[4,6,22–24] This finding does not refute the probable importance of cultural and linguistic aspects of medical care but rather may signify that among Mexican Americans the cost, availability and accessibility constraints may be more important in determining utilization of health services than the cultural and linguistic constraints (as measured in the HHANES). It is possible that accessibility and availability of care (cost, geographic location, hours of operation, etc.) are most closely related to utilization of services while cultural and linguistic aspects of care relate more to satisfaction with care, compliance with treatment, continuation in treatment, etc.

It is unfortunate that Mexican Americans with the highest need for health care (poor perceived health status and functional limitations) tended to report the highest rates of encountering barriers which prevented them from obtaining the needed care. Also, approximately 6 percent of the adult Mexican American population reported not knowing where to go for health services or having a way to get there. Health providers and agencies seeking to increase access to medical care among Mexican Americans can assist by focusing on service delivery aspects (e.g., cost of care, providing convenient hours for the community they serve, decreased waiting time, etc.) and outreach aspects (educational and transportation) to reach those individuals who may not know where to go for care. It is possible that such efforts would increase access to care for all ethnic/racial groups.

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V. Utilization of Curanderos by Mexican Americans: Prevalence and Predictors
Findings from HHANES 1982–84

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Abstract: Data from the Southwest sample of the Hispanic Health and Nutrition Examination Survey (HHANES) were analyzed to examine whether the use of a curandero or other folk medicine practitioner hindered, enhanced, or did not affect the utilization of western health care services by Mexican Americans. Findings revealed that only 4.2 percent of the HHANES sample persons between the ages of 18–74 years reported consulting a curandero, herbalista, or other folk medicine practitioner within the 12 months prior to the survey. Income, self-perceived health status, the language of the interview, and dissatisfaction with modern medical care recently received independently predicted curandero utilization (adjusted OR 2.01 and 1.66, respectively). Low income and self-perceived health status were less strongly related to curandero utilization. [*Am J Public Health* 1990; 80(Suppl):32–35.]

Introduction

Mexican Americans have long been thought to be in generally poorer health than White non-Hispanics as evidenced by shorter life expectancies, and higher infectious, parasitic disease, infant and maternal mortality rates; they appear to be in better health than Black non-Hispanics whose socioeconomic conditions are generally comparable.[1,2] Recent evidence indicates that these disadvantages are diminishing.[3–6] Less progress has been made, however, for those conditions usually associated with a lack of access to health care, such as tuberculosis and diabetes.[2,7–9]

Despite their apparent health needs, Mexican Americans have not achieved expected levels of health care utilization. Unlike Puerto Ricans and Cuban Americans who exhibit higher levels of health care utilization than other White Americans, Mexican Americans demonstrate the lowest level of health care utilization of all ethnic/racial groups (for whom there are data).[6] This underutilization of modern medical care has occurred despite factors which in other groups have been indicative of higher utilization rates (e.g., the stress factors of poverty, acculturation, and crowded housing).[10]

Alternative hypotheses to account for this underutilization include:

- cultural and language differences between patient and provider;
- folk medicine practices as an alternative to that of the modern health care system;
- environmental and socioeconomic conditions creating priorities for daily living inconsistent with the fee-for-service modern health care system.[11]

Contradictory results have been reported on why Mexican Americans underutilize health care services. Some of this research, particularly concerning the use of folk medicine, has been considered a disservice to Hispanics because it focuses on cultural or attitudinal explanations for underutilization while ignoring other possible explanations such as those associated with socioeconomic factors and lack of access to care.[12]

Andersen, *et al*, posited that Hispanics have limited access to medical care due to low levels of income, education, and health insurance coverage.[13] Treviño and Moss found that Mexican Americans with health insurance are 1.5 times more likely to consult a physician than Mexican Americans without insurance.[14] In addition to the monetary restraints, Chesney, *et al*, suggested that acculturation and social isolation are pertinent barriers to medical care for Mexican Americans.[15] While the debate continues as to what the exact barriers to health care are for Mexican Americans, the general consensus is that for Mexican Americans the availability of health care (as distinct from access) is comparable to that of the population in general.[13]

All societies have some systematized manner in which to deal with illness.[16] In the past some Mexican Americans have utilized curanderos or folk medicine practitioners. The number of Mexican Americans who still use curanderos as an alternative to modern medical care, for cultural and/or economic reasons, is unknown.

Most studies of curanderismo, the practice of folk medicine, have sought to describe and evaluate this phenomenon by indirect methods, i.e., through studies focused on the practitioner's patients.[17,18] These studies have produced detailed descriptions of the specific healing techniques used[19] or information on the type of disorder being treated.[17] Little is known about the prevalence of their use by Mexican Americans and what factors differentiate users from non-users. Such factors could include cultural orientation, ability to pay, and dissatisfaction with previous medical care. It is unknown whether curanderismo is used as an exclusive alternative to modern medicine or whether both types of care are used concurrently.

This study seeks to compare those Mexican Americans (ages 18 years and older) in the Southwestern sample of the HHANES who reported consulting a curandero, herbalista, or other folk medicine practitioner within the last 12 months with those who did not do so. A model to predict those who sought alternative care is formulated.

Methods

The Hispanic Health and Nutrition Examination Survey (HHANES), the first national study of the health of the Hispanic population, was conducted during 1982–84 by the National Center for Health Statistics. A more detailed account of the design is presented elsewhere.[20,21] The HHANES sought to obtain representative samples of Hispanics households by concentrating sampling procedures for Mexican Americans in five southwestern States.

Specifically, this analysis includes those Mexican Americans, ages 18 years and older, who responded to the question

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NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

"There are some providers of health care that we sometimes go to, such as curanderos, sobadores, herbalists, spiritualists, and others. Have you seen or talked to any of these persons for health care during the past 12 months?" There are significant differences between curanderos, herbalistas, and other folk medicine practitioners; however, all were included in the single question used in HHANES to access folk medicine utilization. Further, they all represent a traditional medicine alternative to "scientific" medicine. Henceforth in this report, curandero will be used to refer to all of these folk medicine practitioners.

Due to the nature of these data, efforts were undertaken to account for the large size and method of sampling in the analysis. Design effects have been accounted for through the reporting of weighted percentages and adjusted variances, which were computed utilizing the Taylor approximation of the SESUDAAN methodology.[22] Comparisons were made between weighted and unweighted estimates resulting in insignificant variation, sample sizes are presented unweighted while statistical test and percentages utilize weighted estimates.

The variables used in the prediction model were drawn from the literature. They included indicators of: health status, ability to pay for health care, and health care utilization (see Appendix for details of these items), as well as the demographic variables of gender, age, marital status, education, nativity, acculturation, language of interview, family size, and size of the respondent's community or city of residence.

Descriptive and multivariate analyses, including logistic regression (using SAS, Proc Logist; SAS Institute, Inc.), were performed on the data in order to build the model which best predicted curandero utilization with the fewest variables. Odds ratios and 95 percent confidence intervals, using adjusted standard errors, were calculated from beta coefficients.[23]

Results

The total sample size for this investigation includes 3,623 Mexican Americans from the Southwestern United States ages 18 years and over. Of this number, only 148 persons (4.2 percent) reported consulting a curandero, herbalista, or other folk medicine practitioner within the last 12 months.

Users of curanderos were slightly more likely to be male, less well educated, and foreign born (Table 1). Marital status, age, family size, geographical distribution, or size of the community in which they reside were not found to be related to the use of curanderos.

Acculturation was not found to be significantly related to use of curanderos. Subsequent analysis, however, revealed that being interviewed in Spanish was found to be highly predictive of curandero utilization, whereas nativity was not.

Table 2 presents the comparisons of proportions on indicators of health status by users and non-users of curanderismo. During the physical examination portion of the HHANES, the physician was asked to indicate his/her global assessment of the respondent's health status. The vast majority (>85 percent) for both groups were classified by the physician as being in very good or excellent health. There were no differences in physician assessment of health status of Mexican Americans who used curanderos and those who did not utilize them.

Those who consulted a curandero were more likely than those who did not to report their current perceived health status as fair or poor and to believe they had little control over their future health status.

TABLE 1—Demographic Characteristics of Reported Users and Non-Users of Curanderismo

	% Users	% Non-Users
(N)	(148)	(3475)
Gender		
Male	58.1	50.0
Female	41.9	50.0
Ages (years)		
18–44	64.2	65.2
45–64	31.1	29.2
65–74	4.7	5.6
Marital Status		
Married: spouse in household	67.1	66.3
Married: spouse not in household	3.3	1.9
Widowed	5.4	3.5
Divorced	5.3	5.5
Separated	3.3	3.9
Never Married	15.6	19.0
Education		
0–8 years	46.6	36.6
9–11 years	15.4	20.0
12+ years	37.9	43.5
Nativity		
United States	52.0	61.0
Other	48.0	39.0
Acculturation		
1.0–1.9	48.4	33.9
2.0–2.9	17.6	21.1
3.0–3.9	31.1	38.5
4.0–4.9	2.9	6.4
Language of Interview		
English	48.6	61.3
Spanish	51.4	38.7
Family Size (persons)		
1 or 2	22.2	19.6
3 or 4	39.6	40.5
5 or 6	25.3	27.6
7 or more	12.9	12.4
Size of Place (population)		
500,000 or more	27.9	24.2
100,000–499,999	14.4	15.0
25,000–99,999	28.2	27.5
200–24,999	21.7	24.1
Not in a place	7.9	9.2

Those who consulted curanderos in the last year were found to be less satisfied with the care they received at their last visit to a medical practitioner. However, no differences were found regarding having a regular source of care or recency of last visit to a medical practitioner (Table 3). Further, poverty status, the presence or absence of health insurance coverage or the type of coverage were not found to be related to use of curanderos (Table 4).

Logistic regression with backward elimination was applied to this sample in order to delineate which variables out of this theoretical framework were most predictive of curandero utilization. Those variables that remained within the model were: satisfaction with care received at last visit, the language of the interview, self-perceived health status and income (Table 5).

Discussion

As noted by others,[16] relatively few persons of Mexican origin in the United States consult a curandero. Only 4 percent of the adult Mexican Americans interviewed in the HHANES reported that they had consulted a curandero within the past 12 months. Comparable population estimates

TABLE 2—Indicators* of Health Status by Reported Users and Non-Users of Curanderismo

	% Users	% Non-Users
(N)	(148)	(3475)
Health Status (Physician Assessment)		
Excellent	52.9	59.4
Very Good	36.5	28.0
Good	9.0	9.2
Fair	1.1	2.8
Poor	0.5	0.5
Health Status (Self-Assessment)		
Excellent	11.8	13.8
Very Good	15.5	18.1
Good	30.7	34.7
Fair	31.7	28.3
Poor	10.4	5.1
Future Health Locus of Control		
Excellent	37.7	43.1
Good	43.4	44.6
Fair	17.1	8.9
Poor	1.8	3.4

*See Appendix for definitions.

TABLE 3—Indicators* of Health Care Utilization by Reported Users and Non-Users of Curanderismo

	% Users	% Non-Users
(N)	(148)	(3475)
Source of Care		
Regular only	58.8	66.2
Regular & other	7.4	7.1
Other	29.7	24.6
Never visited	4.1	2.1
Visit Interval		
Never	4.1	2.1
<1 month	19.9	19.3
>1 & <12	50.2	47.7
>1 year & <5	23.4	25.0
>5 years	3.3	6.0
Satisfaction with Care		
Very satisfied	69.2	80.8
Somewhat satisfied	14.2	14.4
Not at all satisfied	16.6	4.7

*See Appendix for definitions.

TABLE 4—Indicators* of Ability to Pay for Health Care Services by Reported Users and Non-Users of Curanderismo

	% Users	% Non-Users
Income		
<$20,000	36.7	35.0
≥ $20,000	63.3	65.0
Type of Health Insurance		
Not covered	39.0	35.3
Private	50.2	53.9
Medicare	4.3	4.4
Medicaid	4.9	5.0
Other public	1.7	1.3
Poverty Level		
At or below	24.2	28.1
Above	75.8	71.9

*See Appendix for definitions.

TABLE 5—Logistic Regression Odds Ratios (OR) and 95% Confidence Interval (CI) for the Association of Curandero Utilization with Predictor Model Variables

Variables	OR	(95% CI)
Satisfaction with care	1.66	(1.08, 2.53)
Language of interview (English vs Spanish)	2.01	(1.06, 3.82)
Income (≤$20,000, >$20,000)	0.57	(0.14, 2.41)*
Self-perceived health status	1.28	(0.74, 2.19)*

*These variables were found to be significant in the logistic regression model but use of adjusted standard errors in calculation of the CI included the null value.

for utilization of folk healers in other ethnicities are not available in the literature.

Mexican Americans may be reluctant to discuss use of curanderos and this could have an impact on the findings of this investigation. However, bilingual interviewers of predominantly Hispanic origin were used in the HHANES. While some reluctance to answer questions regarding curanderismo usage may have occurred, the level of reluctance is thought to be decreased by the cultural and linguistic similarity between the interviewers and the sample persons.

It has been hypothesized[13] that, as a consequence of the use of curanderos, Mexican Americans tend to delay seeking medical care, often until the condition becomes critical. The data presented here do not support that view. If this were true, then differences in time since last health care visit and health status would be evident in the two groups compared. This was not found to be the case.

Regression analyses revealed that adherence to a Mexican cultural orientation (in the form of preference to be interviewed in Spanish) and dissatisfaction with medical care received were related to use of curanderos while ability to pay and availability of care (as indicated by the reporting of a regular source of care) were not so related.

It is possible that those persons who spoke Spanish during the interview are experiencing greater difficulty communicating with health care professionals (predominantly monolingual in English) hence are more dissatisfied with the care they received and seek an alternative source. It is reasonable to assume that those persons who do not have the expendable income to "shop" for a physician would also be more likely to show dissatisfaction with care and seek an alternative source of care, accounting for the marginal predictability of income. Similarly those who feel that they are in poor health may be somewhat more likely to seek persons with whom they can communicate more easily, and whom they perceive as being more empathetic—in this case, curanderos.

This research has been a first step in trying to unravel complex relationships. A major limitation of this research involves the small number of Mexican Americans who reported consulting a curandero; this precluded an examination of possible interactive variations which may have occurred with respect to curandero use. Nevertheless, the data indicate that few Mexican Americans consult folk medicine practitioners, and that those who do so also consult physicians. The research suggests that health care professionals should maintain and strengthen their efforts to deal with linguistic and cultural differences in order to be as effective as science allows.

APPENDIX

Variables Used in the Analyses

Perceived control of future health status was derived from the following question: "How much control do you think you have over your future health: a great deal, some, very little, or none?"

Income was derived from the following question: "Was the total combined family income during the past 12 months more or less than $20,000? Include money from jobs, Social Security retirement income, unemployment payments, public assistance, and so forth. Also include income net from interest, dividend, income from business, farm or rent, and any other money income received."

Determination of insurance coverage was an amalgam of several questions. A positive response to one or more of the following would indicate the presence of coverage, a negative response to all would indicate the absence of insurance coverage:

- "Is sample person now covered by Medicare?"
- "Does sample person have a Medicaid card?"
- "Is sample person now covered by any other public assistance program that pays for health care?"
- "Is sample person now covered by CHAMPUS, which is medical insurance for dependents or survivors of disabled veterans?"
- "Is sample person now covered by any other program that provides health care for military dependents or survivors of military persons?"
- "Is sample person covered under this plan?" (referring to for-profit health insurance plans to which they or their employer may subscribe).

Type of insurance coverage was determined by the presence or absence of preceding items. Not covered by insurance is equivalent to no insurance coverage above.

The *poverty level* variable was a dichotomization of those at or above and those below the poverty index. The poverty index is a ratio of two components: the numerator is the midpoint of the income bracket reported for each family; the denominator is a poverty threshold which varied with the number of persons in the family, the adult/child composition of the family, the age of the reference person, and the month and year in which the family was interviewed.[20]

The *time since last visit* was determined by the compilation of two questions:

- "Now I would like to ask you some questions about your last visit to the (care source as previously determined). How long has it been since that visit? Less than one month; one month but less than six months; six months but less than one year; one year but less than five years; more than five years."

A second question has the same response categories with the addition of the choice of "never", and it reads:

- "Now I would like to ask you some questions about your last visit to any clinic, health center, doctor's office, or other place for health care. How long has it been since your last visit for health care?"

The *source of care variable*, speaking of the "scientific" source of health care, comes from three questions:

- "Is there a particular clinic, health center, doctor's office or other place that you usually go to if you are sick or need advice about your health?"
- Have you visited any other clinic, health center, doctor's office or other place for health care since your last visit to the (regular source)?"
- "How long has it been since your last visit for health care?"

A positive response to the first question and a negative response to the second indicates a regular only source of health care; positive responses to both questions indicates a regular and other source of health care; those who responded positively to the second question but negatively to the first indicate other source only; and, a response of "never" to the third question indicates that the respondent has never visited any source of health care.

The *satisfaction with care variable* is derived from the question:

- "In general, how satisfied were you with the care you received at that visit?" Would you say you were very satisfied, some what satisfied, or not at all satisfied?"

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VI. Alcohol Consumption Patterns among Mexican American Mothers and among Children from Single- and Dual-Headed Households: Findings from HHANES 1982–84

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Abstract: Data from the southwestern United States sample of the Hispanic Health and Nutrition Examination Survey were employed to compare the patterns of alcohol use among Mexican American mothers and children in female-headed households with use patterns among mothers and children in couple-headed households. Single female heads of household drank more alcoholic beverages on more days than females from dual-headed households. As a whole, the children of single heads of household still living at home did not demonstrate significantly different drinking patterns from their dual-headed household counterparts. While male children of single-headed households drank more days and total drinks than their dual-headed household counterparts, female children of dual-headed households drank more days and total drinks than female children from single-headed households. [*Am J Public Health* 1990; 80(Suppl):36–41.]

Introduction

The number of single female-headed families in the United States has been increasing during the past three decades. By 1984 over 25 percent of all families that included children were female-headed.[1] Data from Bean and Tienda[2] indicate that 36.5 percent of Puerto Ricans, 18.9 percent of Mexican Americans, and 16.0 percent of Cuban Americans lived in single female-headed families in 1980.

Studies indicate that Hispanic female-headed families are exposed to a variety of potential stressors, such as poverty,[3,4] lack of health insurance,[5] lack of child health care,[6] and lack of social support.[6,7] This suggests they may also be at higher risk for behaviors that have been associated with higher levels of stress, such as alcohol use. Women who had never been married or who were divorced or separated have been found to have lower rates of abstention and higher rates of heavier drinking,[8] especially if cohabitating.

In our analysis of the Hispanic Health and Nutrition Examination Survey data, we attempted to determine if mothers and children in female-headed households (i.e. no male head of household present) displayed alcohol drinking patterns that reflected a greater quantity and frequency of alcohol consumption than did the drinking patterns among the mothers and children from dual-headed households (i.e. both mother and father present) and if factors such as age, acculturation level, education level, and socioeconomic status modified any such relation between household type and drinking patterns. Previous studies[9] have suggested that such factors are partially responsible for differences in behavior observed among single female heads of household and females from dual-headed households.

Methods

The Sample

The Hispanic Health and Nutrition Examination Survey (HHANES) was conducted from 1982 to 1984 by the National Center for Health Statistics (NCHS). The objective of this survey was to secure a representative sample of approximately 12,000 Hispanics in three geographic areas: the southwestern United States, Dade County, Florida, and the New York City metropolitan area.[10] Our research was limited to Mexican Americans (i.e. those with a national origin recode of 1) from the Southwestern sample, since there were fewer cases of single female-headed families among the Cuban and Puerto Rican populations.

The analyses were restricted to those single female-headed (246) and dual-headed (1,022) families in which the mother and at least one of her children under 19 years of age at the time of the interview were sampled (the analytic sample consists of mothers and all of their children who were included as sample people in the HHANES). This strategy assured greater comparability with other investigations of household headship.[11]

Each individual included in the HHANES does not represent the same number of individuals in the actual population, since certain age groups were under- or over-sampled. Therefore, sample weights were used in order to generate correct estimates.[10,12] All analyses were conducted both unweighted and weighted. The unweighted Ns and the weighted statistics are reported unless otherwise stated.

Measures

Individuals ages 12 to 74 were asked questions about alcohol use in the Adult Person Supplement Questionnaire of the HHANES, including:

- on how many of the prior 28 days they had consumed any beer, wine, or liquor;[13]
- total number of drinks (rather than days) summed across all alcohol types consumed during the reference period. One single female head of household (28 years of age, employed, tenth grade education, and living below the poverty level) reported consuming a total of 789 alcoholic drinks during the 28-day reference period;
- the average number of "drinks per occasion" (computed, by dividing the total number of alcoholic drinks consumed during the reference period by the total number of days the subject drank).

Those who had drunk any type of alcohol during the reference period were classified as "drinkers," all others were "abstainers." In females, "high drinking" was defined as having an average of four or more alcoholic drinks per occasion during the reference period and "low drinking" was defined as having one to three drinks per occasion. In males, the corresponding definitions were six or more and one to five. These created variables parallel those employed by Markides, *et al*, in their 1988 three-generation study.[14]

NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

The HHANES included a modified version of an acculturation scale developed by Cuellar, *et al*,[15] which has been extensively utilized among Mexican American populations. The modified scale is comprised of eight items pertaining to language preference, language spoken, language subject reads better, language subject writes better, ethnic identification of the subject, ethnic identification of the subject's mother, ethnic identification of the subject's father, and one item that combined the place of birth of the subject's parents. This scale has a minimum value of 1 and a maximum value of 4.9, with higher scores indicating higher levels of acculturation.

Age refers to the actual age of the individual at time of examination. Education is the number of years of school completed. Employment status was coded 1 for employed (part- or full-time) and 0 for non-employed. Poverty was coded as 1 for persons living below the federal poverty cut point and as 0 for those at or above poverty level. Income reflects the combined family income (categorized) over the 12 months prior to the interview. All of the dual heads of household were self-identified as a spouse of a head of household or as head of household with a spouse.

None of these variables had a non-response rate of greater than 10 percent for the mothers and 12 percent for the children. The majority of the questions were answered by nearly all subjects in the sample. Therefore, the effects of non-response are believed to be minimal.

Analyses

The variables (total drinks, total number of drinking days, and drinks per occasion) were examined within each household type for three age categories among the mothers, 17–29, 30–39, 40–74 (approximate tertiles), using analysis of variance.

Analysis of covariance was employed to test the hypothesis that mothers and children of single-headed households would consume more alcohol than those in dual-headed households when controlling for age, acculturation, combined family income, and education. Multiple classification covariance analysis (see, e.g., Nie, *et al.*[16]) produces adjusted means across the values of each independent variable. Analysis of covariance (ANCOVA) employed total number of drinks as the dependent variable with dual vs single household type as the independent variable. The covariates—including combined family income, acculturation level, education level, and age—were then entered into the procedure. Adjusted means were obtained for each level of the independent variable. This same procedure was employed for two additional ANCOVAs using, respectively, the dependent variables of total number of days drank and number of drinks per occasion.

Analysis of covariance was also employed to explore children's drinking patterns. Three separate analyses were conducted, using total number of drinks, total number of days, and number of drinks per occasion, respectively, as the dependent variables and household type as the independent variable. The covariates in each analysis were age, education, gender, combined family income, and acculturation.

Regression coefficients and their standard errors are presented for the covariates of each analysis of covariance. Standard errors have been adjusted for design effects[10,12] (design effects were calculated employing the Taylor approximation technique available with the SESUDAAN program[17]).

TABLE 1—Sociodemographic Variables of Females and Children (ages 12–18 years) of Single and Dual Households

Variables	Mothers		Children	
	Single Household (n = 246)	Dual Household (n = 1022)	Single Household (n = 201)	Dual Household (n = 624)
Age Categories				
% 12–14 years	NA	NA	44.2	47.0
% 15–16 years	NA	NA	29.1	28.0
% 17–29 years	26.3	36.4	26.7	25.0
% 30–39 years	35.3	37.7	NA	NA
% 40–74 years	38.4	25.9	NA	NA
Education Level				
Mean	8.6	9.1	8.9	8.7
Standard Error	.24	.11	.13	.08
% In Poverty	64.5	26.3	70.3	31.2
Acculturation				
Mean	2.6	2.5	3.3	3.2
Standard Error	.07	.03	.05	.03
% Employed	58.2	44.3	NA	NA
% Males	NA	NA	45.7	51.7
Family Size				
Mean	3.7	4.8	4.9	5.9
Standard Error	.12	.05	.18	.07

SOURCE: NCHS Hispanic Health and Nutrition Examination Survey

Results

An examination of marital status indicated that the majority of single female heads of household were divorced (34.5 percent) or separated (33.1 percent). The remainder of the single females were either widowed (18.1 percent) or had never been married (14.3 percent). Examination of the marital status of the children of these women revealed that just nine were married and four were separated while the remainder had never been married. Tables 1 and 2 present weighted means and percents for the alcohol variables as well as sociodemographic characteristics of mothers and children controlling for household type. More single mothers (and their children) were living in poverty and were more likely to be employed in comparison with their dual-headed counterparts (Table 1). The observed differences between mothers and children regarding percent impoverished and family size are a function of a lack of a one-to-one correspondence between mothers and children (The statistics would be the

TABLE 2—Alcohol Consumption Variables of Females and Children (ages 12–18 years) of Single and Dual Households

Variables	Mothers		Children	
	Single Household (n = 246)	Dual Household (n = 1022)	Single Household (n = 201)	Dual Household (n = 624)
Total No. Days Drank				
Mean	2.0	.9	.7	.7
Standard Error	.32	.11	.19	.11
No. Drinks per Occasion				
Mean	4.7	2.7	4.1	3.8
Standard Error	.47	.13	.54	.38
Total No. Drinks				
Mean	12.4	2.5	3.3	2.5
Standard Error	3.90	.30	1.10	.46
% High Drinkers	46.0	23.8	38.4	23.4
Drinker vs Abstainer				
% Drinkers	44.4	25.0	17.6	17.0

SOURCE: NCHS Hispanic Health and Nutrition Examination Survey same if there was a one-to-one correspondence.)

There were 92 single female heads and 214 females of couple-headed households who were drinkers; 29 children who were drinkers were in single households and 84 were in dual-headed households; 46 percent of the single female heads of household who were drinkers were high drinkers compared to 24 percent of the female drinkers in dual-headed households (Table 2). Examination of the percentages of drinkers across marital status of single female heads of household indicated that there were a greater proportion of drinkers among those who were divorced (47.9 percent) or separated (41.0 percent) than those who were never married (33.3 percent) or were widowed (32.9 percent).

When sociodemographic characteristics of mothers from single and two-parent households were examined controlling for drinker type (i.e. abstainer vs drinker), families of drinking women tended to be smaller than families of abstaining women. Women who were drinkers had higher education levels and were less likely to be impoverished than abstainers. Drinkers from both household types had a higher level of acculturation and a greater percentage employed than abstainers. The analysis of variance (ANOVA) procedures indicated that there were no significant differences between the three age categories of mothers in single- and dual-headed households for the dependent variables of total number of days drank, total number of drinks, and drinks per occasion.

The proportion of children living in poverty was less among drinkers than abstainers. The children who were drinkers were slightly older. In order to determine if the proportion of drinkers varied across age groups among the children, the percentage of drinkers in three age categories (i.e. 12–14, 15–16, 17–19 years) was computed. While cell sizes were small for the youngest age categories, no significant differences in the percent of drinkers across age groups were found, even when controlling for household type.

Results of the ANCOVA procedure indicated that the weighted crude mean total drinks for single heads of household was 13.17 and for females of dual-headed families it was 2.46. When the covariates—highest level of education achieved, combined household income, age, and acculturation—were taken into consideration, the resulting weighted adjusted means were 21.91 drinks for singles and .32 drinks for duals (Table 3). The second panel of Table 3 provides the regression coefficients (bs) and standard errors (adjusted for design effects) of the covariates. These results indicate that household type had a strong negative association with total number of drinks consumed, meaning that single heads of household drank more than women from couple-headed families. Acculturation was found to have a positive relationship with total number of drinks, indicating that women who were more acculturated tended to drink more.

Single female heads of household drank a weighted mean of 2.12 days and females of couple-headed households drank a weighted mean of .92 days; adjusted weighted means were 3.34 and .62 days, respectively (Table 3). The strongest relationship found between covariate and number of days drank was a negative one with household type. The remaining three covariates had weaker positive associations with the dependent variable.

The adjusted weighted means of number of drinks among females per occasion were 6.06 for single household heads and 2.23 for dual household heads (Table 3). As with the previous analyses, household type was discovered to have a strong inverse relationship with the dependent variable, number of drinks per occasion.

Because one single female head of household reported 789 drinks for the 28-day reference period, we analyzed the data after excluding her. In addition, a logarithmic transformation of the three dependent variables was computed from the data (including this single head of household) because of the skewed distribution. These new values were utilized in the three ANCOVAs. These procedures produced results comparable to those shown in Table 3.

Since acculturation appeared to have the most influence (other than household type) with respect to the dependent variables, further analyses were undertaken to uncover its relationship with these measures. It was found that among both single and dual female heads of household, acculturation levels were significantly higher among those who consumed more alcohol.

Analysis of covariance was also utilized to examine the children's (ages 12 to 18 years) continuous drinking measures. Covariates included age, education, gender, combined

TABLE 3—Analysis of Covariance of Mothers' Three Continuous Drinking Measures

	Female Heads of Household								
	Total Number Drinks			Total Number Days Drank			Drinks per Occasion		
	N	Crude	Adjusted*	N	Crude	Adjusted*	N	Crude	Adjusted*
Household Type									
Single	202	13.17	21.91	202	2.12	3.34	84	4.83	6.06
Dual	827	2.46	.32	825	.92	.62	195	2.76	2.23
Total (Grand mean)		4.57			1.16			3.38	
Multipe R^2		.028			.057			.139	
		b	SE		b	SE		b	SE
Covariates									
Age		−0.107	0.091		−0.004	0.011		−0.025	0.025
Education		0.031	0.311		0.025	0.038		−0.108	0.119
Income		−0.016	0.107		0.045	0.037		−0.036	0.021
Acculturation		1.169	1.092		0.419	0.148		0.259	0.260
Household Type		−10.881	2.334		−1.519	0.340		−1.765	0.564

*Adjusted for acculturation, age, education, and combined family income.
SOURCE: NCHS Hispanic Health and Nutrition Examination Survey.

family income, and acculturation level, with household type as the independent variable. The weighted adjusted mean number of total drinks during the reference period was 3.80 for children in single-headed households and 2.42 for children of couple-headed households, .75 and .68 respectively for total drinking days, 3.59 and 4.17 respectively for drinks per occasion (Table 4).

None of these ANCOVAs examining the continuous drinking variables for the children indicated that household type had a strong relationship with the dependent variables. However, all three analyses exploring the children's drinking patterns demonstrated strong associations between the covariates age, sex, and acculturation and the dependent variables (Table 4). In order to discover how these covariates were related to the continuous drinking variables, several analyses were done. Male children of single heads of household were found to drink more and on more occasions than male children from two-parent homes (Table 5). Whereas, female children of dual-headed households drank more than those from single households. No significant differences were found between high vs low drinkers or abstainers vs drinkers with respect to level of acculturation or age. Drinking children were slightly older than non-drinking children in both single- and dual-headed households (16.4 years compared to 14.5 years).

In order to determine if drinking status among children was related to drinking status of mother, proportions of drinking children (controlling for gender) were computed for abstaining and drinking mothers of each household type. As shown in Table 6, percentages of drinking daughters were similar among abstaining mothers from couple-headed households (11.9 percent) and abstaining single heads of household (9.2 percent). A greater proportion of drinking daughters came from two-parent homes with a drinking mother (23.3 percent) than came from single-parent homes with a drinking mother (11.5 percent). Among single-headed families with abstaining mothers, 35.6 percent of the sons were found to drink, while 16.9 percent of the sons from dual-parent homes with abstaining mothers did so. Within single-parent families having a drinking mother, 20.7 percent of the sons drank. It was found that 26.2 percent of the sons in two-parent homes with a drinking mother were drinkers also. Analyses indicate that these gender differences do not appear to be related to a variation in age distribution.

Discussion

As hypothesized and as found in other ethnic groups, there was greater use of alcohol among parents in non-intact families compared to those from intact families,[18,19] even when age, acculturation level, education, and income were taken into consideration. Acculturation did appear to play a role in drinking behaviors, since women drinkers of both single- and dual-headed households had higher levels of acculturation.

It has been suggested in other studies that more acculturated Mexican American women do have a tendency to have higher alcohol consumption.[13,14,20,21] Higher levels of acculturation do not explain why single female heads of household consume much more alcohol than their dual counterparts, however. Stressors of being a single female head of household need to be explored to ascertain what, if any, role they have in exacerbating drinking behaviors of single female heads of household.

It has been suggested by others[9] that when socioeconomic status is controlled, differences between single- and dual-headed households become non-significant. However, this study does not support such findings with respect to alcohol consumption patterns. In fact, we found that when such factors as income and education are controlled for, the differences between women of the two household types became more pronounced. Therefore, other elements must be contributing to the heavier alcohol consumption among single female heads of household. This conclusion is supported by the relatively small values of the adjusted R^2's for the ANCOVAs—suggesting that the independent variables explain little of the variance.

Since we have no data on initiation of alcohol use in conjunction with changes in marital status, it may be that marriage breakdown was due partially to the drinking behav-

TABLE 4—Analysis of Covariance of Children's (ages 12–18) Three Continuous Drinking Measures

	Children (ages 12–18)								
	Total Number Drinks			Total Number Days Drank			Drinks per Occasion		
	N	Crude	Adjusted*	N	Crude	Adjusted*	N	Crude	Adjusted*
Household Type									
Single	164	3.39	3.80	163	.69	.75	26**	4.02	3.59
Dual	490	2.56	2.42	490	.70	.68	70	4.01	4.17
Total (Grand mean)		2.77			.70			4.01	
Multiple R^2		.086			.105			.220	
		b	**SE**		**b**	**SE**		**b**	**SE**
Covariates									
Age		1.627	0.642		0.409	0.120		0.754	0.493
Education		−0.133	0.604		−0.071	0.111		−0.213	0.519
Gender		−3.061	1.147		−0.643	0.224		−1.856	0.735
Income		−0.009	0.060		0.018	0.015		−0.043	0.042
Acculturation		1.503	0.677		0.304	0.148		0.952	0.530
Household Type		−0.551	1.428		−0.076	0.333		0.591	0.978

*Adjusted for acculturation, age, sex, education, and combined family income.
**Statistic does not meet a minimum reliability standard (due to small cell size).
SOURCE: NCHS Hispanic Health and Nurtrition Examination Survey

TABLE 5—Comparison of Continuous Drinking Measures for Children (ages 12–18) by Household Type

	Male Children				Female Children			
	Single Household		Dual Household		Single Household		Dual Household	
	N	Weighted Mean	N	Weighted Mean	N	Weighted Mean	N	Weighted Mean
Total Drinks	80	6.30	270	3.50	100	.75	275	1.48
S.E.		2.34		.82		.37		.37
Total Days Drank	80	1.18	270	.94	99	.24	274	.44
S.E.		.40		.19		.10		.09
Drinks per Occasion	20**	4.66	41**	4.73	8**	2.68	38**	2.67
S.E.		.65		.64		.71		.29

**Statistic does not meet a minimum reliability standard (due to small cell size).
SOURCE: NCHS Hispanic Health and Nutrition Examination Survey

TABLE 6—Weighted Percentages of Children Classified as Drinkers Controlling for Drinking Status of Mother

	Children Classified as Drinkers	
Status of Mothers	% Male	% Female
Single Household		
Abstainer	35.6	9.2
Drinker	20.7	11.5
Dual Household		
Abstainer	16.9	11.9
Drinker	26.2	23.3

SOURCE: NCHS Hispanic Health and Nutrition Examination Survey

iors of these females or that being single allowed these women more opportunity to consume alcohol.

The findings regarding female children are surprising. One would expect that daughters of single female heads of household would drink more than daughters of dual household heads, but we found the reverse to be the case. Additionally, sons of abstaining single mothers were more likely to be drinkers in comparison with both sons of abstaining dual mothers and sons of drinking mothers of either household type. Of course, within couple-headed families, children have a father who may act as a role model for their drinking behaviors. This could explain the findings regarding children if fathers were more likely than mothers to be drinkers.

In summary, these data suggest that single female heads of household drink significantly more than women in couple-headed families. This research indicates that single female heads of household are at increased risk for greater consumption of alcohol. While a lower percentage of mothers from couple-headed households consume alcohol, their numbers are greater. This information may be of assistance to those who implement preventive and intervention measures and treatment, especially since data indicate that alcohol-related mortality is particularly high among Mexican Americans.[22] Additionally, further research needs to be done to investigate the factors contributing to the drinking behaviors among these women, such as change in marital status and psychological stressors. In this way, treatment and intervention may become more effective.

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VII. Acculturation and Alcohol Consumption in the Mexican American Population of the Southwestern United States: Findings from HHANES 1982–84

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Abstract: Data from the Southwestern sample of the Hispanic HANES are employed to evaluate the relationship of acculturation into the larger society with alcohol consumption. As in previous work, acculturation was not found to be related to alcohol consumption of Mexican American men, but was positively related to the consumption of younger Mexican American women. Among middle-aged women, acculturation was not important. However, we found evidence that middle-aged women might be turning to alcohol in response to marital disruption and poverty. In addition, middle-aged women who are not employed are less frequent drinkers but those who drink are heavier drinkers than employed women. [*Am J Public Health* 1990; 80(Suppl):42–46.]

Introduction

In recent years, a number of papers focusing on predictors of alcohol consumption among Mexican Americans have been published. By far, the leading predictor of interest has been "acculturation" into the larger society.[1–4] The concept of acculturation has actually assumed great importance in studies of Mexican Americans in general during the 1980s, particularly in research on mental health.[5,6] Despite its increasing importance, little progress has been made in both conceptualizing and measuring acculturation.

Gilbert and Cervantes,[2] who have reviewed much of the literature on acculturation and alcohol consumption among Mexican Americans, have suggested two models generally followed.

- The *acculturative stress model*, according to which higher and/or more frequent alcohol consumption is the result of the many stresses accompanying the process of acculturation into the larger society. Higher drinking would thus be expected in persons at the middle of the acculturation continuum, and not at the extreme ends.
- The *acculturation model*, on the other hand, predicts that alcohol consumption patterns of Mexican Americans would reflect the extent to which they have adopted the drinking norms and practices of the larger society.

The literature has been mixed with regard to support of these perspectives.[1–2,4] In general, however, it appears that the "acculturation" model tends to be more predictive of the behavior of women.[1,2] With regard to men, the literature has been less clear-cut.[1]

Working from these two perspectives, Markides, *et al*,[3] hypothesized that the "acculturative stress" model would have relevance to the drinking experience of men, while the "acculturation" model would have more relevance for women. The latter hypothesis was based on the relatively low drinking rates of Mexican American women. Since, as a group, they drink little, women would be less likely to turn to alcohol as a way to relieve any stress associated with acculturation.

Markides, *et al*,[3] tested these hypotheses using data from a three-generation study of Mexican Americans living in the San Antonio area. Among men, they found that acculturation was related to lower alcohol consumption in the middle generation (middle-aged people). Since virtually all of the middle-generation subjects were born in the United States, people at the low end of the acculturation scale were at the middle of the acculturation continuum, and thus, the results were interpreted as consistent with the "acculturative stress" hypothesis. Among women, acculturation was positively related with alcohol consumption in the younger generation, as predicted by the acculturation hypothesis. However, middle-generation women behaved much like their male counterparts as they appeared to drink more if they were less "acculturated."

This paper attempts to replicate the above study using data from the more representative southwestern United States sample from the Hispanic Health and Nutrition Examination Survey (HHANES). Thus, the analyses are conducted separately by sex and for three age groups: 20–39, 40–64, and 65–74 years. These correspond roughly with the ages of the three-generations in Markides, *et al*.[3] However, the middle and younger age groups have more variation on acculturation since they also include first-generation (foreign-born) Mexican Americans.

Methods

The data were collected as part of the Adult Sample Person Supplement of the southwestern sample of the Hispanic HANES.[5] Our analysis is limited to the Mexican American respondents from the five Southwestern States (Texas, New Mexico, Colorado, Arizona, and California). The Adult Sample Person Supplement Questionnaire contains a long series of questions regarding alcohol consumption. We used several variables which enabled us to construct similar measures to those employed by Markides, *et al*.[3] Respondents were asked how many days altogether they drank beer during the four-week period ending on the Sunday prior to the interview. Next, they were asked how many beers they drank per day during the days they drank beer. They were also asked how many beers they drank in total during the four-week period. These questions were repeated with regard to wine and with regard to "liquor such as: whiskey, rum, gin, vodka or tequila." Respondents were also asked on how many days they drank any kind of liquor.

Using the above information, we were able to create the following variables: *Frequency* refers to the number of days a person had consumed any alcoholic beverages during the 28-day reference period. *Volume* refers to the average num-

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NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

ber of drinks consumed per day by those who drank. *Total Drinks* refers to the total number of drinks consumed during the 28-day period by all respondents. *High Drinking* refers to the percentage of men who drank six or more drinks a day when they drank, and women who drank four or more drinks a day when they drank. *Drinkers vs Abstainers* refers to the percent of respondents who had drunk any alcoholic beverages during the 28-day reference period (coded 1 for drinkers and 0 for abstainers).

The key independent variable in our analysis is "acculturation." The Hispanic HANES utilized a shortened eight-item version of the Cuellar acculturation scale, which is the most widely used scale in research with Mexican Americans.[7] Items included captured the respondents' language use and preference, ethnic identification and nativity, both for the respondent and his/her parents. Internal consistency reliability for the scale is in excess of .90.

Other variables employed were more straightforward. *Age* was actual age at the time of the interview; *Education* refers to years of school completed; *Marital Status* was coded 1 for married persons (spouse present) and 0 for all others; *Poverty* was coded 1 for people living below the federal poverty line and 0 for all others; finally, *Employment* was coded 1 for persons who were employed (full-time or part-time) at the time of the interview and 0 for all others.

The five alcohol measures discussed earlier were regressed on the acculturation scale and the five control variables: age, education, marital status, poverty, and employment. The analysis was performed separately by sex and for three age groups: ages 20-39, 40-64, and 65 and over. As mentioned above, these age groups correspond roughly to the three generations in Markides, *et al*,[3] who have shown that the influence of acculturation on alcohol consumption varies by generation (age) and sex. All analyses were performed with appropriate adjustments for sample weights and design effects. Design effects were necessary because the Hispanic HANES employed a complex multi-stage probability sample design. Sample weights were normalized by multiplying the number of subjects in each age/gender group employed in the analysis with each respondent's weight divided by the sum of the weights for the group. Design effects were computed using the Taylor Approximation of the SESUDAAN program and were subsequently employed to adjust the variances in the regression analyses. Examination of correlation and covariance matrices did not reveal evidence of multicollinearity (Intercorrelation tables are not presented but are available from the authors upon request). Regression analyses employed listwise deletion of missing values which led to the loss of cases ranging from 9 to 15 percent.

The analysis is aimed at evaluating the usefulness of the "acculturative stress" and "acculturation" perspectives.[2] As mentioned earlier, we expect the former to have more relevance for men and the latter to have more relevance for women. However, based on our unexpected findings with middle-aged women in the three-generation study,[3] we also examine the possibility that some middle-aged women in this sample might resort to alcohol consumption as a way to relieve stress related to acculturation or other factors.

Results

Table 1 presents means and percents on the five alcohol measures described above by sex and age group. Maximum sample sizes for each group are shown at the top. These ranged from 1,016 younger females to 84 older males. Number of cases for the alcohol variables vary because of missing values and because nondrinkers are not included in the measurement of some variables. For example, volume is the average number of drinks per day when a person drank. Only people who had drunk during the 28 days prior to the interview are included. This means considerably small sample sizes, particularly among women and older people, most of whom are not drinkers.

As Table 1 shows, drinking is considerably more frequent and heavier among younger and middle-aged men as previous studies have shown. Although these men do not appear to be very frequent drinkers when compared with men in the general population, they drink heavily when they drink, which is consistent with findings from previous studies.[2,4,8]

TABLE 1—Alcohol Consumption Variables and Sociodemographic Variables by Gender and Age Group

Variables	Ages 20–39		Ages 40–64		Ages 65–74	
	Male (N = 822)	Female (N = 1016)	Male (N = 558)	Female (N = 726)	Male (N = 84)	Female (N = 119)
Frequency						
(mean Number of Days)	6.4	1.4	7.8	1.4	4.0	.92
(N)	(821)	(1015)	(556)	(725)	(84)	(119)
Volume						
(Mean)	4.9	3.2	4.4	3.0	3.4	1.9
(N)	(587)	(331)	(368)	(182)	(38)	(17)
Total Drinks						
(Mean)	28.0	4.8	33.9	5.6	13.1	1.5
(N)	(821)	(1016)	(557)	(726)	(84)	(119)
High Drinking						
(% 6+ Males, 4+ Females)	31.4	28.1	24.6	24.9	20.7	0
(N)	(587)	(331)	(368)	(182)	(38)	(17)
Drinkers vs. Abstainers						
(Percent drinkers)	72.6	34.5	69.5	26.3	46.8	14.2
(N)	(822)	(1016)	(558)	(726)	(84)	(119)
Age	28.5	28.6	50.2	50.5	69.1	69.8
Education (mean yrs)	10.4	10.2	8.2	7.6	5.4	4.8
Percent Married	70.9	67.2	89.4	71.6	81.5	42.6
Percent in Poverty	22.0	30.0	21.1	31.5	44.1	58.1
Acculturation	2.6	2.7	2.4	2.3	2.2	2.2
Percent Employed	94.2	53.5	84.1	45.9	13.5	6.8

Table 1 also presents data (means or percents) on several sociodemographic variables included in the regression analyses. As would be expected, acculturation is highest in the younger age group and lowest in the oldest. Also, the poverty rate is higher among women and the elderly. Other variables are distributed by sex and age as might be expected. As expected, consumption is much lower in the older age group, and much higher among men than among women in all three age groups.

Table 2 presents the results of the regression analyses for men and Table 3 of the analyses for women. The analyses were conducted separately for three age groups. The top panel of Table 2 shows the results for younger men (ages 20–39). As will be seen, acculturation is not associated with any of the alcohol variables in younger men. Of the other variables, marital status is negatively related to frequency and total drinks consumed (married men drink less); education is negatively related to volume of consumption and the probability of being a high drinker; similarly, living in poverty is positively associated with volume of consumption and probability of being a high drinker; finally, employment is associated with greater frequency of drinking.

The results for middle-aged men (Table 2) show no notable associations between acculturation and any of the alcohol measures. Age was negatively associated with the probability of being a drinker, while education was positively related with the same variable and with frequency of consumption. On the other hand, education was negatively associated with volume of consumption and the probability of being a high drinker. Married men had lower volume of consumption and consumed fewer total drinks and poverty was associated with less frequent consumption.

As would be expected, fewer associations were observed with older men, although this is partly the result of small numbers. Table 2 shows a negative association between age and the probability of being a drinker while marital status is positively associated with the same variable.

Table 3 shows the results for women. Among younger women, acculturation is positively associated with frequency of consumption and the probability of being a drinker. More educated younger women are more likely to be drinkers but they consume a lower volume of alcohol and are less likely to be high drinkers. Marital status is negatively associated with all five alcohol variables. Finally, employment is positively related to the probability of being a drinker.

Among middle-aged women, acculturation is positively related to the probability of being a drinker, but not to any of the other alcohol variables. Age was negatively associated with the probability of being a drinker, volume of consumption, total drinks consumed, and the probability of being a high drinker. Marital status was negatively associated with volume of consumption, the probability of being a high drinker, and the probability of being a drinker. Poverty was negatively associated with the probability of being a drinker; however, it was positively associated with volume of consumption and the probability of being a high drinker. Finally, employed middle-aged women were more likely to be drinkers and to be frequent drinkers. However, they consumed a lower volume of alcohol and were less likely to be high drinkers.

Among older women we find that education is positively associated with the probability of being a drinker. No other associations are noted but, again, the small number of cases is a problem.

Discussion

As shown in a number of previous studies,[1,2] acculturation is not related to alcohol consumption among men in any consistent manner. We expected a negative association between acculturation and alcohol consumption among men,

TABLE 2—Results of Multiple Regression Analysis of Alcohol Consumption: Males

	Frequency		Volume		Total Drinks		High Drinking		Drinkers vs Abstainers	
	b	SE	b	SE	b	SE	b	SE	b	SE
					Ages 20–30					
Age	.149	.082	.018	.049	.264	.430	.017	.025	.013	.018
Education	.009	.140	−.371	.072	−1.051	.712	−.134	.039	.048	.033
Marital Status	−1.931	.860	−.958	.554	−11.611	4.953	.203	.289	−.228	.214
Poverty	−.360	1.043	1.258	.681	5.470	5.132	.583	.350	−.183	.203
Acculturation	.663	.439	.394	.271	4.040	2.574	.171	.138	.057	.103
Employment	3.602	.512	−.101	1.092	14.864	8.687	.192	.565	.183	.448
(N)	(746)		(544)		(746)		(544)		(747)	
					Ages 40–64					
Age	−.058	.075	−.036	.033	−.781	.469	−.027	.025	−.04[illegible]	.016
Education	.342	.126	−.204	.060	1.420	.839	−.144	.042	.100	.030
Marital Status	−2.553	1.840	−2.152	.692	−32.179	10.223	−.148	.456	−.272	.381
Poverty	−2.760	1.157	.836	.589	4.419	8.002	.451	.384	−.386	.250
Acculturation	−.870	.764	.399	.283	−.058	4.796	.202	.199	−.117	.133
Employment	−.881	1.748	−.698	.879	−1.508	9.804	−.249	.530	.590	.308
(N)	(491)		(326)		(491)		(326)		(493)	
					Ages 65–74					
Age	−.016	.386	−.110	.189	−.008	1.739	−.562	.336	−.216	.108
Education	.178	.265	−.166	.187	.164	1.205	−.041	.309	.075	.080
Marital Status	3.766	2.173	.963	1.566	10.750	11.167			1.474	.742
Poverty	−.167	1.867	−.520	1.174	1.938	8.929	−.886	1.713	.229	.714
Acculturation	−.870	1.189	.765	.711	6.781	5.401	.982	1.149	.081	.361
Employment	.881	2.739	−.174	1.798	−9.401	12.440			−.607	.859
(N)	(73)		(32)		(73)		(32)		(73)	

NOTE: OLS regression coefficients are presented for frequency, volume and total drinks, and logistic regression coefficients for high drinking and drinkers vs abstainers.
*$p < .05$, **$p < .01$

TABLE 3—Results of Multiple Regression Analysis of Alcohol Consumption: Females

	Frequency		Volume		Total Drinks		High Drinking		Drinkers vs Abstainers	
	b	SE	b	SE	b	SE	b	SE	b	SE
Ages 20–30										
Age	.026	.031	.010	.034	.105	.207	−.003	.036	.018	.021
Education	.074	.051	−.184	.061	−.097	.432	−.120	.063	.081	.036
Marital Status	−1.221	.318	−.947	.426	−7.036	2.058	−.621	.427	−.964	.209
Poverty	−.442	.348	.869	.516	1.999	3.133	.571	.439	−.242	.253
Acculturation	.433	.158	.416	.217	1.591	1.137	.171	.186	.431	.102
Employment	.457	.316	−.175	.423	2.256	2.062	−.359	.433	.462	.227
(N)	(919)		(305)		(919)		(305)		(920)	
Ages 40–64										
Age	−.026	.028	−.136	.045	−.580	.279	−.084	.035	−.037	.016
Education	.063	.052	−.043	.093	.061	.528	−.045	.071	.056	.030
Martial Status	−.326	.425	−1.394	.706	−8.425	3.888	−1.468	.459	−.796	.240
Poverty	−.109	419	2.384	.823	7.634	4.416	1.468	.479	−.551	.200
Acculturation	.422	.229	.256	.404	4.004	2.296	−.130	.271	.343	.127
Employment	.921	.385	−1.413	.737	3.683	3.676	−1.263	.468	.893	.248
(N)	(621)		(158)		(621)		(158)		(622)	
Ages 65–74										
Age	.249	.158			.246	.242			.019	.100
Education	.131	.135			.174	.207			.303	.141
Marital Status	−.111	.943			−.584	1.439			−.955	.696
Poverty	−.238	.964			.410	1.514			−.414	.662
Acculturation	.620	.554			1.168	.845			.485	.376
Employment	2.314	1.888			2.912	2.965			.235	1.177
(N)	(102)				(102)				(102)	

NOTE: OLS regression coefficients are presented for frequency, volume and total drinks, and logistic regression coefficients for high drinking and drinkers vs. abstainers.
$^*p < .05$, $^{**}p < .01$

particularly in middle-age, as [illegible] he case in the three-generation study by Markides [illegible]l.[3] The lack of such negative association may very we[illegible] result from the higher variance on the acculturation scale among middle-aged men in this study than the second generation men in the three-generations study, virtually all of whom were born in the United States.

With regard to women, acculturation appears to be more predictive, as shown by previous research.[1–3] As found by Markides, *et al*,[3] a positive association is observed in younger women with both frequency and volume of consumption, as well as the probability of being a drinker. However, no association is observed among middle-aged women. Furthermore, no tendency is observed toward a negative association between acculturation and alcohol consumption in middle-aged women as was the case with middle-generation women in Markides, *et al.*[3] Although this difference might be again the result of greater variance in acculturation in the present study, there is no evidence that middle-aged Mexican American women are turning to alcohol as a way to relieve "acculturative stress." However, there is evidence that middle-aged women might be turning to alcohol as a way to relieve stress resulting from other factors, such as poverty and marital disruption. Thus, although poverty is negatively associated with the probability of being a drinker, among middle-aged women who drink, poverty is positively related to the volume of consumption, total number of drinks, and the probability of being a high drinker. Similarly, non-married middle-aged women (mostly divorced or widowed) were heavier drinkers. Finally, the effect of employment is in a direction suggesting heavier drinking among housewives, who are presumably more traditional. Even though middle-aged employed women were more likely to be drinkers and were more frequent drinkers, of those who were drinkers, housewives drank more heavily.

In sum, there is only partial support for an "acculturation" model with regard to alcohol consumption for women and no consistent support for an "acculturative stress" model for either sex. We hope to have demonstrated that the influence of acculturation on alcohol consumption among Mexican Americans is highly complex and depends on such factors as variation in the acculturation continuum, age, sex, and type of measure of alcohol consumption.

We believe that our findings also have implications for the broader literature on the health and mental health of Hispanics where a lively interest has been shown in the concept of acculturation. This research has yielded unclear results with regard to the role of "acculturative stress," because of conceptual and measurement problems, and difficulties in establishing exactly at which point on the acculturation continuum stress is at its highest.[7]

We also feel that studies of the health behaviors and health status of Mexican Americans and other ethnic populations will benefit from introducing a life course perspective into their approach to the data analysis. For example, there is evidence that the concept of acculturation has different meaning and influence at different stages of the life course,[10] as well as for the two sexes, as the present analysis has shown.

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VIII. Patterns of Cigarette Smoking among Hispanics in the United States: Results from HHANES 1982–84

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Abstract: In the 1982–84 Hispanic Health and Nutrition Examination Survey, the prevalence of cigarette smoking was examined among Mexican Americans, Puerto Ricans, and Cuban Americans in the United States. Among 20–74 years olds, the age-adjusted smoking rates for Mexican American, Puerto Rican, and Cuban American men were high—42.5, 39.8, and 41.6 percent, respectively. Quite striking among Cuban American men was the high smoking rate among 20–34 year olds (50.1 percent), the highest smoking rate in the three Hispanic groups compared. The age-adjusted smoking rates for Mexican American, Puerto Rican, and Cuban American women were much lower than those for men—23.8, 30.3, and 24.4 percent, respectively. Both Puerto Rican and Cuban American men were more likely to be heavy smokers (52.3 and 64.1 percent, respectively, smoking a pack or more a day) as compared to the Mexican Americans (33.8 percent smoking a pack or more a day). The pattern was the same for women, with Mexican American women being lighter smokers (18.8 percent smoking a pack or more a day) as compared to heavy smoking among Puerto Rican and Cuban American women (35.1 and 48.6 percent, respectively, smoking a pack or more a day). Given the health hazards of smoking, future research and intervention are required for those groups with high exposure to cigarette smoking. [*Am J Public Health* 1990; 80(Suppl):47–54.]

Introduction

In recent years, several studies have shown that the prevalence rates of smoking among Hispanics in the United States are relatively low in comparison to non-Hispanic Whites and Blacks. Most studies have examined Hispanic populations either in specific geographic areas or in particular ethnic groups, such as Mexican Americans in Sacramento, California[1–4] or in San Antonio, Texas.* National data have come primarily from the National Health Interview Survey (NHIS) which uses the term "Spanish Origin" to describe those of Hispanic ancestry.[5] These data may not reflect the true rate of smoking in the Hispanic US population since the NHIS data have not been collected with a Spanish language instrument nor have the interviewers been bilingual. In general, the number of Hispanics in most studies has not been large enough to be representative or to produce reliable estimates for analysis. This is particularly relevant if one attempts to disaggregate Hispanic data among various population subgroups, e.g., Mexican Americans, Puerto Ricans, and Cuban Americans.

The Hispanic Health and Nutrition Examination Survey (HHANES) was a probability-based survey of three distinct Hispanic populations in the United States.[6] For HHANES, the targeted population consisted of three groups of civilian noninstitutionalized persons ages six months to 74 years, from three areas of the US. The three groups were: 1) Mexican Americans residing in selected areas of Texas, California, Colorado, New Mexico, and Arizona (otherwise known as the Southwest); 2) Cuban Americans residing in Dade County (Miami), Florida; and 3) Puerto Ricans residing in the greater New York City area.

Smoking among Hispanics is currently gaining greater recognition as a public problem since cigarette manufacturers are now aggressively promoting cigarettes to the Hispanic population.[7,8] A recent report noted that these promotional efforts include advertisements in publications aimed at minority groups, sponsorship of entertainment and cultural events drawing large minority audiences, and extensive use of billboards in minority neighborhoods.[7]

Although the cigarette industry views this as an economic issue, for the Hispanic community it is more importantly an issue of maintaining a healthy population. A number of studies have documented the diseases associated with smoking, particularly for lung cancer and cardiovascular diseases. However, several studies have indicated a low incidence of lung cancer in Hispanics, which has been attributed to the low smoking rates of Hispanics in the study samples.[9–12] If the smoking rates of Hispanics are increasing, it would be tragic if Hispanic lung cancer rates reached parity with the majority population. Evidence for a significant rise in both lung cancer and COPD (chronic obstructive pulmonary disease) mortality rates in Hispanic males has been reported recently in New Mexico for the period 1958 to 1982.[13] These data serve as an early warning signal for the future health of Hispanics, particularly if cigarette smoking rises in this population.

Given the young median age of the Hispanic population (25.1 years vs 31.9 years for the total population) and rapid growth of this population (14.6 million in 1980 and 18.8 million in 1987),[14,15] the need to prevent smoking becomes even more critical in ensuring that high rates of disease are not in its future. Trevino and Moss[16] indicate the vulnerability of the Hispanic population to high morbidity and mortality rates due to the low utilization of health services and the fact that about 30 percent of Mexican Americans (the largest Hispanic group) are without health insurance. Other health care barriers such as language, transportation, and lower education levels add to this population's vulnerability and thus increase the need for developing sound risk factor reduction programs for the prevention and cessation of smoking.

Methods

HHANES Survey Design

Details of the HHANES sample design, selection process, operational plan, and quality control procedures have been documented elsewhere.[6] As noted in the foreword section of this supplement, the HHANES was a survey of three major Hispanic subgroups in selected areas of the United States[17] conducted over a two-year period (1982–84) in three regions of the United States: Mexican Americans in

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NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

*Haffner S, Rosenthal M, Hazuda H, Stern M: Cigarette smoking (SMK) in Mexican Americans (MA) and Anglo Americans (AA). The San Antonio Heart Study. Paper presented at the 111th annual meeting of the American Public Health Association, Dallas, TX, November 13–17, 1983.

five Southwestern states, Cuban Americans in Dade County (Miami), Florida and Puerto Ricans in the New York metropolitan area including parts of New York, New Jersey, and Connecticut. The sample design of HHANES was a stratified, multistage, probability sample of persons six months through 74 years of age. Data from all three portions of the survey are presented in this report.

The HHANES included both an interview and a three-hour medical examination conducted in a specially designed mobile examination center. Smoking history and other medical history data were collected during the household interview. The interviews were conducted in either English or Spanish, depending upon the language preference of the respondent. The vast majority of sample persons who stated they wanted to be interviewed in one language participated throughout the survey in that language. All persons ages 18 years and older responded to the questionnaires themselves unless they were physically or mentally unable to be interviewed.

The study population for this report included adults 20 through 74 years of age who met the eligibility criteria for Mexican American, Cuban American, or Puerto Rican, respectively. The analysis included those persons who completed the household interview and the medical examination. Persons not medically examined were excluded from this analysis because their smoking history responses could not be validated in the plasma cotinine study, to be described subsequently. Thus, we included only those persons for whom we could scientifically comment on the validity of the responses.

Of the 4,735 Mexican American adults ages 20–74 years who were sampled in the survey, 3,326 (70 percent) completed the household interview and medical examination, and were included in this report. Likewise, 865 (out of the sample 1,481) adult Cuban Americans and 1,220 (out of the sample 1,764) adult Puerto Ricans in this age range completed the two parts of the examination, reflecting response rates of 58.4 percent and 69.2 percent, respectively. Because these response rates are not high, as noted in the methodological paper to this supplement,[17] some caution in interpreting the results is advisable.

NHIS Survey Design

The 1985 National Health Interview Survey (NHIS) data presented in this report were analyzed by Marcus and Crane.[18] Their report was based on data collected in a continuing nationwide survey conducted on households representative of the US civilian noninstitutionalized population (one randomly selected respondent per household). Household members were interviewed by trained personnel of the US Bureau of the Census and information was obtained about the health and other characteristics of each respondent. In the 1985 NHIS, 33,045 respondents completed the smoking supplement. Standard NHIS protocols were followed in the survey, and response rates were approximately 95 percent.

In the NHIS survey, persons 17 years of age and over could respond for themselves and any responsible adult who was married or 19 years of age or older could answer questions for any other related person in the household, which may have led to some error in reporting.

Data Definitions

The cigarette smoking questions were asked of all adults during the household interview. A smoker was defined as anyone who had ever smoked at least 100 cigarettes in his/her life time. Current smokers included those among the smokers who smoked cigarettes at the time of the survey. The amount of cigarettes smoked was asked in terms of the usual number of cigarettes smoked per day, with packs equal to 20 cigarettes. The NHIS survey used similar definitions as those noted above. A validation of self-reported smoking with plasma cotinine levels was also conducted.[19] Respondents were also asked what brand of cigarettes they usually smoke.

Among the demographic variables examined in this study, education was grouped according to the highest grade or year of regular school the sample person completed. Income was defined as the total combined family income during the previous 12 months from any source. Acculturation was defined from the eight-variable scale, as described in the methodological paper for this supplement,[17] and was examined only in the Mexican American sample since the scale was not designed to assess acculturation levels of Puerto Ricans or Cuban Americans. Acculturation scores were divided into tertiles indicating low, medium, or high acculturation levels, with low acculturation indicating Mexican orientation, medium acculturation indicating bi-cultural bi-lingual, and high acculturation indicating US orientation.

Statistical Analysis

Sampling weights, specifically exam weights, were applied when calculating prevalence estimates in order to account for individual selection probabilities and adjustments for nonresponse, noncoverage, and post-stratification (Mexican American sample only) which resulted from the complex survey design used in HHANES. Each of the analytic variables was examined first using age-specific data. Since there were differences in the age composition of the three Hispanic populations, estimates were age-adjusted by means of direct standardization, using the United States 1980 Census population as the standard. These rates were computed using the program SESUDAAN.[20]

The complex survey design used in the HHANES tends to increase the variance which would have been obtained through simple random sampling.[21] As described by Kovar,[22] the design effect is the ratio of the variance of a statistic calculated from a complex sample to the variance of the same statistic calculated from a simple random sample. For HHANES, the average design effect for current smoking rates was 1.1 for Mexican Americans, .7 for Cuban Americans, and 1.3 for Puerto Ricans. Since these effects were all close to 1.0, the simple random sample variances were used in statistical testing unless noted otherwise. Two-tailed t-tests ($p < 0.05$) were used to compare point estimates. Standard errors presented in the tables were calculated using the SESUDAAN program, which takes the complex survey design into account. All data analyses were done using programs accessible through Statistical Analysis System.[23]

Since this paper is based solely on cross-sectional data, which does not allow us to investigate etiologic relationships, only descriptive statistics are presented. Multivariate analyses were not considered appropriate since the purpose of the paper was descriptive in nature.

Limitations

The cross-sectional design prohibits one from making antecedent-consequence statements, as well as from separating out any effects of selective survival on the responses. Persons who previously died because of cigarette smoking or could not participate in the examination because of illnesses due to cigarette smoking are not represented in our findings.

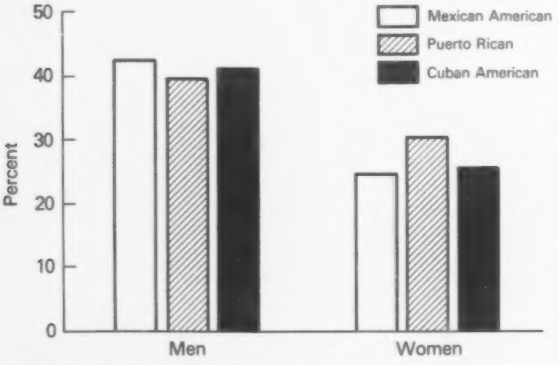
Likewise, the less than adequate response rates in the examined sample, particularly for Cuban Americans and Puerto Ricans, could have biased some of the associations. However, only slight differences were observed in the proportion of men and women who completed the examination cycle as compared to the original sample selected for study. For example, the proportion of men in the examined sample as compared to the original sample (in parentheses) among Mexican Americans 43.9 percent (47.5), Cuban Americans 43.6 percent (44.8), and Puerto Ricans 36.5 percent (39.2) did not vary by more than a few percentage points. Likewise, the percentage of older persons (ages 45–74) among the examined sample did not vary significantly from the original sample for Mexican Americans 37.7 percent (40.3), Cuban Americans 59.4 percent (58.8), or Puerto Ricans 44.2 percent (45.0).

The validation of self-reports of the number of cigarettes smoked per day with plasma cotinine levels for Mexican Americans has recently been published in this Journal.[19] The authors concluded that significant underreporting (22.6 percent) occurred in those Mexican American smokers reporting one to nine cigarettes smoked per day. There were no demographic characteristics that could be identified to characterize the underreporters. A report by Coultas *et al.*[24] among New Mexico Hispanics also found discrepancies between self-reported and validated cigarette smoking. After adjustment for cotinine and carbon monoxide levels, the age-standardized prevalence of current smokers in that study ranged from 30.9 percent (self-reported) to 39.1 percent in males and from 27.1 percent (self-reported) to 33.2 percent in females. Thus, the smoking rates reported by some Hispanics are conservative estimates of the true rates, particularly for the amount smoked.

The inconsistencies between the number of self-reported cigarettes smoked and the results of cotinine concentrations are probably due to underreporting of the quantity of cigarettes smoked per day by a proportion of Mexican American light smokers.[19] However, differences in cotinine metabolism or extremely efficient smoking are alternative explanations that cannot be ruled out by the two studies reported.[19,24]

Results

Figure 1 shows the prevalence rates of cigarette smoking among men and women in the three Hispanic groups. About 40 percent of Hispanic men were current smokers, with age-adjusted rates of 42.5, 39.8, and 41.6 percent in Mexican American, Cuban American, and Puerto Rican men, respectively. With the exception of Puerto Ricans, men were about twice as likely to smoke as women. Puerto Rican women had the highest rates of smoking, at 30.3 percent, which narrowed the sex difference in this ethnic group.



NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

FIGURE 1—Age-adjusted Prevalence Rates of Current Smoking among Three Hispanic Groups in the HHANES by Sex

The age-specific smoking rates, shown in Table 1, yielded some interesting differences in the three Hispanic populations. Among men, the very high rate of smoking (50.1 percent) in young Cuban men ages 20–34 years was striking. Mexican American men had the highest rates of smoking of the three ethnic groups for ages 35–54 and 55–74 years. Among women, Puerto Ricans were smoking at higher rates than Mexican American or Cuban Americans in the two youngest ages, 20–34 and 35–54 years, with rates of 38.6 and 33.2 percent, respectively. The rates of smoking were markedly lower in the oldest age group in all three Hispanic groups, ranging from a low of 13.7 percent in Puerto Ricans to 19.5 percent in Mexican Americans.

Since comparisons of the Hispanic population with the non-Hispanic White and Black populations of the US are often made, Table 2 compares the age-specific rates, by 10-year age groups, from HHANES with smoking rates in the National Health Interview Survey conducted in 1985. The most noticeable difference was the finding that current smoking rates in the three Hispanic groups were generally higher than the rates observed for non-Hispanic Whites in NHIS, and were only slightly lower than the rates for Blacks. Exceptions were observed among Cuban Americans, where the youngest Cuban American men (ages 25–34) had markedly higher rates than Blacks (57.7 vs 45.2 percent, respectively), and where some of the older Cuban American men had about 10 percent lower rates than Blacks (ages 45–54 and 65–74).

Table 3 presents the percentage of smokers according to the amount smoked (<10, 10–19, and 20+ cigarettes per day) by age, sex, and Hispanic group. In general, the Mexican American population had a much lighter smoking pattern than the Puerto Rican and Cuban American populations. Even if we were to assume that one-fifth of the Mexican Americans who reported smoking <10 cigarettes smoked higher amounts, based on the cotinine validation study,[19] the Mexican Americans would still be lighter smokers than the other two Hispanic groups. About 52 percent of Puerto Rican male smokers and 64 percent of Cuban male smokers consumed 20+ cigarettes a day. These rates are about two times the heavy smoking rates the Mexican American rate of 34 percent rates as well as White male population cited in NHIS (37 percent).

Puerto Rican and Cuban American women smokers were also smoking large amounts of cigarettes. About one-half of Cuban women smokers and about one-third of Puerto Rican women smokers were smoking 20+ cigarettes per day. These rates are about two times those of Mexican American women in HHANES and White women in the NHIS. No marked differences from this pattern were observed for men or women when specific age groups were examined.

Since the brand of cigarette also influences health risk, we examined the usage of various cigarette brands in men and women (Figures 2 and 3). Among Hispanic men, the most popular brands used were Marlboro and Winston, together comprising 66.9, 59.0, and 46.2 percent of most often used brands among Mexican American, Puerto Rican, and Cuban American men, respectively. Contrary to expectation, ethnic brands were not used with great frequency, with the highest proportions observed for Cuban Americans (9.2 percent). Of further note was the large use of Newports by Puerto Rican men (21.0 percent) and of Benson and Hedges by Cuban American men (15.6 percent).

TABLE 1—Prevalence Rates of Current Smoking among Three Hispanic Groups in the HHANES by Sex and Age

Hispanic Ethnic Group	Sex–Age Groups							
	Men				Women			
	total (age-adjusted)	20–34	35–54	55–74	total (age-adjusted)	20–34	35–54	55–74
Mexican American								
%	42.5	40.7	44.0	43.2	23.8	22.2	29.0	19.5
± SE		1.9	2.2	3.0		1.4	1.7	2.2
Unweighted N		271	231	121		181	194	68
Puerto Rican								
%	39.8	44.7	38.8	33.6	30.3	38.6	33.2	13.7
± SE		3.9	3.7	4.7		2.9	2.6	3.0
Unweighted N		74	70	38		114	107	24
Cuban American								
%	41.6	50.1	39.2	31.6	24.4	29.2	25.0	16.2
± SE		5.3	3.8	4.3		4.3	2.9	2.9
Unweighted N		46	65	38		32	49	26

NOTE: Rates are weighted to reflect the values that would occur if the entire Hispanic population had been studied.

TABLE 2—Comparison of Current Smoking Prevalence Rates among Three Hispanic Groups in the HHANES with non-Hispanic Whites and Blacks from the 1985 Health Interview Survey

Hispanic Ethnic Group	Sex–Age Groups									
	Men					Women				
	25–34 %	35–44 %	45–54 %	55–64 %	65–74 %	25–34 %	35–44 %	45–54 %	55–64 %	65–74 %
Mexican American	42.5	43.5	44.9	44.2	41.5	23.6	30.4	26.9	21.1	16.6
Puerto Rican	41.9	42.7	33.4	32.8	35.9	41.1	34.3	30.3	12.0	16.6
Cuban American	57.7	42.3	36.8	39.0	17.7	34.7	30.1	19.3	20.6	9.7
Non-Hispanic Whites	37.1	36.3	33.4	30.1	21.2	32.6	31.4	32.9	27.4	17.3
Blacks	45.2	44.9	47.4	44.6	31.0	35.7	40.2	37.0	28.9	18.6

NOTE: Rates are weighted to reflect the values that would occur if the entire Hispanic population had been studied.

A different pattern of cigarette brand usage was seen among women in Figure 3, with Marlboro, Winston, and Salem making up a large percentage of brands used, with combined percentages of 59.7, 46.5, and 47.2 percent usage for Mexican American, Puerto Rican, and Cuban American women, respectively. Puerto Rican women favored Newports (22.0 percent) and Cuban American women favored Benson and Hedges (18.7 percent).

Socioeconomic status has often been cited as an important correlate of cigarette smoking. Table 4 and Figures 4–5 present smoking prevalence rates by income and educational level, respectively. Among men, education was inversely associated with cigarette smoking prevalence rates, for all three Hispanic groups (Figure 4). Among women, no inverse trend was observed. Women with 7–11 years of education tended to have the highest smoking rates for all three Hispanic groups. When income associations were examined in Table 4, the inverse trends were observed for Mexican American and Puerto Rican men only, with those in the lower income group smoking at greater rates than those in the higher income group. For women, similar patterns were observed and more marked for Mexican American and Cuban American groups. With the exception of the education-smoking observation in women, the data generally suggest an inverse association of socioeconomic status and smoking prevalence for both men and women.

Because income and educational levels do not reflect the degree to which the Hispanic population has adopted the US lifestyle, the association of acculturation with current smoking rates was examined for one group of Hispanics, Mexican Americans, in Figure 6. Acculturation was associated with cigarette smoking only among Mexican American women, increasing from 19 percent among Mexican-oriented women to 28 percent among US-oriented women ($p < .05$). For men, there was no clear trend for smoking and acculturation.

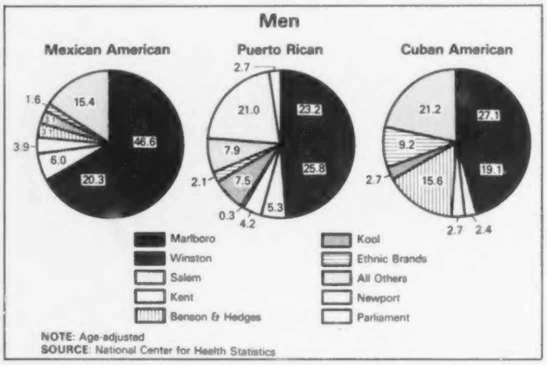
Discussion

The adverse health consequences of smoking are now widely known and accepted.[25] The health consequences of smoking that probably have the most public health impact are coronary heart disease, lung cancer, and chronic obstructive pulmonary disease. Excess rates of these diseases have not yet been observed among Hispanics as compared with the White population. If it is true, as the data show, that Hispanic smoking rates are substantially higher than those for Whites, it is likely that future Hispanic rates of these smoking-related diseases will increase. Likewise, if the estimates we have presented are conservative because of self-reporting biases, the findings of high smoking rates in Hispanics are even more dramatic than we have presented.

TABLE 3—Amount Smoked (%) by Hispanic Ethnic Group from the HHANES by Sex and Age

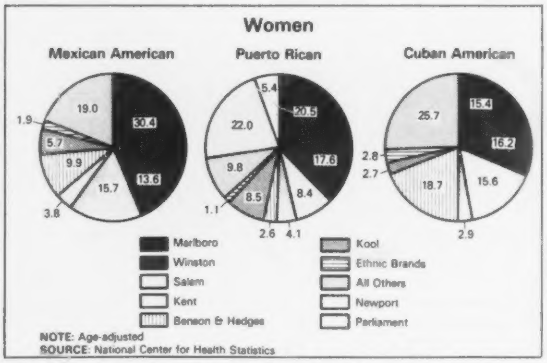
Ethnic Group/ Cigarettes Smoked per Day	Sex - Age Groups														
	Men							Women							
	Total (age-adjusted)	20–34		35–54		55–74		Total (age-adjusted)	20–34		35–54		55–74		
	%	%	(±SE)	%	(±SE)	%	(±SE)	%	%	(±SE)	%	(±SE)	%	(±SE)	
Mexican American															
< 10	41.1	47.7	(3.0)	40.8	(3.3)	31.2	(4.2)	52.2	60.0	(3.7)	46.6	(3.6)	47.3	(6.1)	
10–19	25.1	26.1	(2.6)	22.8	(2.7)	26.4	(3.9)	29.0	24.9	(3.2)	29.3	(3.2)	34.9	(5.7)	
20 +	33.8	26.2	(2.7)	36.4	(3.2)	42.5	(4.5)	18.8	15.1	(2.7)	24.1	(3.1)	17.8	(4.8)	
Puerto Rican															
< 10	20.7	20.1	(4.8)	22.3	(5.3)	19.5	(6.7)	32.5	28.0	(4.3)	27.8	(4.5)	45.6	(10.4)	
10–19	27.0	25.5	(5.0)	25.2	(4.8)	31.8	(6.4)	32.5	39.1	(4.4)	30.9	(4.4)	24.0	(8.7)	
20 +	52.3	54.4	(5.8)	52.6	(6.0)	48.7	(8.2)	35.1	32.9	(4.5)	40.7	(4.8)	30.4	(9.5)	
Cuban American															
< 10	17.1	17.0	(5.4)	20.3	(5.0)	13.2	(5.6)	33.4	30.2	(8.3)	33.4	(6.9)	38.6	(9.7)	
10–19	18.8	25.3	(6.3)	15.6	(4.2)	13.0	(5.3)	17.9	20.5	(6.5)	12.8	(5.0)	20.7	(7.6)	
20 +	64.1	57.8	(7.3)	64.1	(6.1)	73.8	(7.2)	48.6	49.4	(9.0)	53.9	(7.6)	40.7	(10.0)	

NOTE: Percentages are weighted to reflect the values that would occur if the entire Hispanic population had been studied.



NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

FIGURE 2—Proportion of Cigarette Brands Smoked among Three Hispanic Groups of Men in the HHANES



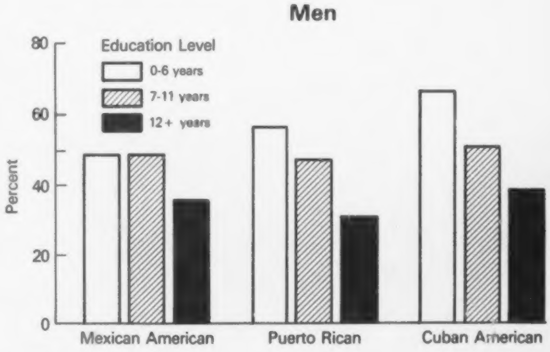
NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

FIGURE 3—Proportion of Cigarette Brands Smoked among Three Hispanic Groups of Women in the HHANES

TABLE 4—Age-Standardized Prevalence Rates of Current Smoking among Three Hispanic Groups in the HHANES by Sex and Income

Sex and Income Group	Mexican American		Puerto Rican		Cuban American	
	%	±SE	%	±SE	%	±SE
Men						
$ < 10,000	55.1	1.6	53.0	4.6	43.2	5.1
10,000 +	39.6	2.4	33.0	3.3	42.0	3.0
Women						
$ < 10,000	29.9	1.8	31.9	3.4	27.9	4.5
10,000 +	21.2	1.2	28.0	2.2	23.5	1.3

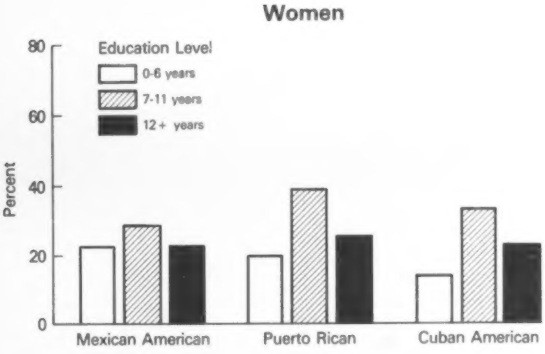
NOTE: Rates are weighted to reflect the values that would occur if the entire population had been studied. Standard errors were calculated using the SESUDAAN program (211)



NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

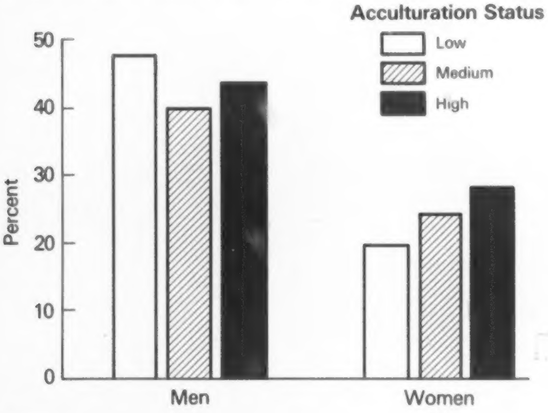
FIGURE 4—Age-adjusted Prevalence Rates of Current Smoking among Three Hispanic Groups of Men in the HHANES by Educational Level

The HHANES results show a different picture from that reported previously.[3,6,8,26] Hispanic men in all three ethnic groups had significantly higher smoking rates than those of non-Hispanic White men in the US. In addition, Puerto Rican women had significantly higher rates of smoking than other Hispanic women, and somewhat higher rates than those of non-Hispanic White women in younger age groups. The 42.5 percent rates of cigarette smoking in the Mexican American males is quite similar to the estimates reported for men in the



NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

FIGURE 5—Age-adjusted Prevalence Rates of Current Smoking among Three Hispanic Groups of Women in the HHANES by Educational Level



NOTE: Age-adjusted
SOURCE: National Center for Health Statistics

FIGURE 6—Age-adjusted Prevalence Rates of Current Smoking among Mexican American Men and Women by Acculturation Status

late 1970s in California, New Mexico, and Texas.[6,12,26–29][**] Likewise, a recent study by Markides, *et al*,[10] among Mexican Americans in San Antonio showed a 45.8 percent rate of smoking among adults ages 18 and above. Thus, it appears that the overall smoking rates in Mexican American males are not on the decline, in contrast to the trend that has been observed for other White males in this country. Estimates of smoking among Puerto Rican and Cuban American males from the 1979 and 1980 NHIS surveys were also consistent with the 40 percent rate.[5]

Comparisons of Hispanic Americans with Hispanics in the countries of origin are useful in assessing the effect of migration and acculturation on the smoking habits in the US. Data on the smoking rates in Mexico in the 1970s and 1980s have been reviewed by Silva,[30] and show a consistent range of current smoking rates in men between 40 and 45 percent.[31],[†] In the same review cigarette smoking rates in women ranged between 15 and 31 percent. Thus, the overall rates for Mexican Americans in the HHANES study are comparable to rates reported in Mexico.

The best survey of Puerto Rican adults came from the Puerto Rican Heart Study, the baseline of which was conducted between 1965–68.[32] In that study, 44 percent of men ages 45–64 years were current smokers, although urban men had significantly lower rates than rural men. Since the HHANES study of Puerto Ricans was conducted in urban areas in the US, the lower rates among the urban men in Puerto Rico are comparable to the smoking rates in the HHANES Puerto Rican men. No data on Puerto Rican women are available for comparison.

Smoking data from Cuba are scarce. Only one report could be found, by Joly and Acosta,[33] who studied Cuban students in grades 10 to 12. Between 40 and 50 percent of students ages 18 and above smoked at least one cigarette per day. The authors speculated that the ultimate prevalence of smoking among Cuban adults is likely to be considerably higher than that found in students 18 years old and over. Again, these reports of high smoking rates are consistent with the 50 percent rates observed in the HHANES Cuban American males ages 20–34 years.

Although several studies have indicated that Hispanics are lighter smokers than other Whites and Blacks,[5,18] our results show that this is the case only for the Mexican American population. We have also seen from the cotinine validation study that these rates are not valid, and about one in five reported light smokers are really heavy smokers.[19] For Puerto Rican males in the New York City area and Cuban American males in the Dade County area, our data show a quite different experience, i.e., the prevalence of heavy smokers (20+ cigarettes per day) is about twice as high as the percentage of light smokers. Our findings are consistent with those of other studies in noting that the brands of cigarettes smoked by these Hispanic groups are high in tar and nicotine.[8,34][††]

The data did not allow us to examine other high-risk smoking behaviors such as inhalation, smoking the cigarette down to the tip, and average time between awakening and smoking first cigarette. However, a recent study by Marin, *et al*,[35] indicated that 49 percent of Mexican Americans (males and females) in their San Francisco sample of current smokers inhaled into the chest; 32 percent burned all the cigarette; and the average wait time to the first cigarette was 257 minutes. Men had slightly worse smoking behavior on these three factors, with 54 percent inhaling, 39 percent burning all the cigarette, and waiting 243 minutes to first cigarette. These findings suggest that there is a serious health risk among smoking Mexican Americans, as well as Cuban Americans and Puerto Ricans.

One factor that may be responsible for the high rates of smoking in the Hispanic populations is the impact of advertising on these populations. It is well recognized that cigarette manufacturers are now targeting the Hispanic and other minority populations with increased expenditures to distribute their message.[7,8,36] Direct advertising to Hispanics is not the only strategy followed by the cigarette industry. Public marketing techniques such as sponsoring meetings, publishing Hispanic directories, and offering monetary contributions to national and community Hispanic organizations to conduct highly visible programs are also used.[7] Given the young median age of the Hispanic population and its potential for tremendous growth over the next several years, it is not likely that the cigarette industry will reduce its efforts in targeting this population. Thus, the public health and medical communities as well as the Hispanic advocacy organizations must recognize this danger and respond to it appropriately.

[**] Stern MP, Haffner SM, Hazuda HP, Rosenthal M: Cardiovascular disease in Mexican Americans. Conference on Chronic disease among Mexican Americans, in Woodland, MO, December 2–6, 1984.

[†] Puenite Silva FG: Resultados de encuestas sobre el habito de fumar en tres muestras (poblacion suburbana/rural personal medico desiete centros hospitalarioso y personal de Petroleos Mexicanos). Implicaciones y consideraciones. Trabajo presentado en: II Reunion de Investigacion del Instituto Mexicano de Psiquiarria. Mexica, Noviembre de 1984.

[††] Carrillo TE, Torres IM: Risk factor prevalence among Hispanics: Socioeconomic status, diet and obesity, cigarette smoking, hypertension and alcohol. Planning for the year 2000. Sixth Biennial National Hispanic Conference on Health and Human Services. New York, September 1986.

To deal with the threat of increased smoking behavior in the Hispanic population, it will be also necessary to direct preventive efforts to specific Hispanic sub-populations. Using birth cohort data from HHANES, Escobedo and Remington[37] showed that recent cohorts of Hispanic men have reduced cigarette smoking, while recent cohorts of Hispanic women have made little progress or have actually increased their cigarette smoking. The authors recommended that intervention efforts should be especially targeted toward Cuban American and Puerto Rican women, since the proportion of smokers among successive cohorts of these women appears to have increased markedly. The association of more acculturation with cigarette smoking in women has also been reported in a recent survey of San Francisco Hispanics.[38] The authors note that this may reflect current social norms for smoking in the United States, and should be taken into consideration in the design of prevention and cessation programs for this group. In this era of health promotion and disease prevention, high rates of smoking-related diseases can and should be avoided in the Hispanic population if the proper attention and resources are devoted to prevention.

ACKNOWLEDGMENTS

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IX. Acculturation and Marijuana and Cocaine Use: Findings from HHANES 1982–84

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Abstract: We examined the relation between acculturation and illicit drug use among Hispanics in the United States employing data from the 1982–84 Hispanic Health and Nutrition Evaluation Survey (HHANES). Across all Hispanic groups, acculturation into US society, as reflected in English language use, was associated with higher rates of illicit drug use even after sociodemographic variables such as gender, age, income, and education were considered. Significant interactions between language and education indicated that the predominant use of English was more strongly associated with marijuana and cocaine use among Mexican Americans and Puerto Ricans of lower educational attainment than among those of higher educational attainment. Significant interactions between language use and other factors such as sex, marital status, and place of birth were also associated with marijuana and cocaine use. These results suggest that the experience of acculturation, especially as it relates to drug use, is closely tied to the social and economic context in which an individual lives. [*Am J Public Health* 1990; 80(Suppl): 54–60.]

Introduction

Drug use has long been recognized as a major public health problem in the United States,[1] and increasing indicators of serious use in the last two decades have prompted a surge in research to identify patterns and risk factors for drug use in general populations.[2,3] However, these studies have generally not provided reliable epidemiological data on drug use among minorities, especially Hispanics. When data on Hispanics have been reported, most studies have failed to distinguish between Mexican Americans, Puerto Ricans, and Cuban Americans. Failure to specify results by Hispanic subgroup greatly limits the usefulness of such reports for public health efforts since, by the year 2000, Hispanics will be the largest minority group in the United States.[4] While anecdotal, clinical, and some community-based studies suggest that drug use may be a significant problem in Hispanic communities,[5–11] information on general drug use prevalence and the associated risk factors in specific Hispanic groups is essential for prevention and intervention efforts in this population.

One critical experience shared by all Hispanic subgroups is the process of acculturation or culture change resulting from continuous, first hand contact with the United States culture. Since acculturation may involve changes in attitudes, norms, and practices regarding use of illicit drugs, it is important to understand the relation of acculturation to drug use. Psychoactive drug use among Hispanics may be generally associated with increased levels of acculturation into US norms and lifestyle.[12–15] Some research has suggested[16,17] that acculturation may be more strongly associated with the use of some psychoactive substances, such as alcohol, among women than men. Whether acculturation is also more strongly associated with illicit drug use among women than men has not yet been investigated. While these findings on acculturation are suggestive, their generalizability has been limited due to the select and small samples in the reported studies. Most such studies have been limited to one specific Hispanic group or have not identified the group under study. It is also unclear from previous research whether acculturation is associated with increased drug use in all Hispanic groups. Furthermore, because acculturation is associated with improved socioeconomic status,[18] it is unclear to what extent increased drug use is prompted by economic rather than acculturative factors. Moreover, the possible interactions between acculturation and sociodemographic factors, such as sex and other demographic variables, have not yet been systematically investigated.

This paper investigates the extent to which illicit drug use among Mexican American, Puerto Rican, and Cuban American adults is associated with place of birth and language use as indicators of acculturation, and whether this relation differs across gender, age, and socioeconomic status.

Methods

The methods and sampling design used in the Hispanic Health and Nutrition Evaluation Survey (HHANES) are described in detail elsewhere.[19] Briefly, the HHANES is a complex, multistage, stratified, clustered sample of households drawn from three geographic regions (i.e., Southwestern US, Northeastern US, and Dade County, Florida) with the largest national concentrations of Hispanics. Households were screened for eligible respondents, who were asked general information about individuals in the household. The second part of the study involved physical examination and interview at a nearby mobile examination unit. Questions on drug use were included in the Adult Sample Questionnaire Supplement and administered in the interview portion of the study to individuals 12 to 74 years of age.[19]

The present analyses include respondents 20 years of age and older who self-identified as Mexican American in the Southwestern US sample, Puerto Rican in the Northeastern US sample, or Cuban American in the Dade County, Florida sample and who completed the physical examination and interview portions of the study. All respondents were asked questions on marijuana use, but only those younger than 45 years were asked questions about cocaine use. While the HHANES also included questions on use of inhalants and sedatives, data on these substances are not included in this paper due to an insufficient number of users. The participation rates for those approached, aged 20–74, were 58.4 percent among Cuban Americans, 69.2 percent among Puerto Ricans, and 70.2 percent among Mexican Americans. The non-response rate for drug questions did not exceed 1.3 percent. The Mexican American sample includes 3,303 respondents (ages 20–74) who were asked about marijuana use and 2,054 (ages 20–45) who were asked about cocaine use; the Puerto Rican sample, 1,209 and 673 respondents respectively, and the Cuban American sample, 858 and 348 respondents respectively.

NOTE: Author affiliations are listed elsewhere under CONTRIBUTORS.

Questions on drug use were limited to whether the respondent had ever used the drug in question (lifetime use) and the most recent periods of use. Due to the small number of respondents who reported use in the last month and use in the last six months, analyses were conducted only on lifetime and previous year's use (no/yes) of marijuana and cocaine. Information was also obtained on sociodemographic characteristics such as sex, age, marital status, years of education, current employment status, and yearly household income. The HHANES acculturation measure, originally developed for the Mexican American sample, is based on eight items measuring language use, ethnic identification, and birthplace of respondent and respondent's parents. An analysis of the distribution of these items for Puerto Ricans and Cuban Americans revealed that responses to some of these items are highly skewed, rendering the measure inappropriate for general use across all Hispanic groups. To develop an acculturation measure that was equally applicable to all groups, the highly skewed items were deleted and acculturation was measured by: 1) place of birth (coded as within or outside the continental US); and 2) a language index derived from the simple mean of self-ratings on language spoken, language preferred, language written, and language read (each scored English only = 1, mostly English = 2, both English and Spanish = 3, mostly Spanish = 4, Spanish only = 5), and language of interview (coded as English = 1, Spanish = 5).

Statistical Analyses

Age adjusted rates for marijuana and cocaine use: Marijuana and cocaine use rates were calculated for each Hispanic subgroup by gender. Marijuana and cocaine use rates were calculated adjusting for age by a direct standardization method. That is, each of the three Hispanic samples was weighted to reflect the age distribution of the combined weighted sample which reflects the Hispanic population in the United States. Standard errors were calculated accounting for design effects using the RTIFREQS procedure in SAS.[20] These standard errors were used to calculate 95 percent confidence intervals for drug use rates from each of the three Hispanic populations.

Marijuana and cocaine use by place of birth and language use: Marijuana and cocaine use rates by place of birth and language use were calculated. The RTIFREQS procedure in SAS[20] was employed to calculate use rate estimates and their standard errors while accounting for design effects.

Multivariate analysis to assess relationship of acculturation to drug use controlling for socioeconomic factors: To investigate whether indicators of acculturation were independently associated with drug use after the effects of socioeconomic factors were removed, a series of logistic regression analyses were conducted using LOGIST procedure in SAS.[21] The analyses were conducted separately for Mexican Americans and Puerto Ricans; the number of users in the Cuban American sample was too small for multivariate analysis to be meaningful. Use in the year prior to interview (no/yes) was chosen as the dependent variable for the analyses because it was the most recent measure of drug use with a sufficiently large sample to allow multivariate analyses. The sociodemographic variables in the model were: sex (male/female), respondent's age (continuous), yearly family income ($<$20,000/$\geq$20,000), currently employed (no/yes), years of education (0–17), and marital status (measured by two dummy variables: separated/divorced/widowed [no/yes] and never married [no/yes], with married as the comparison group). The indicators of acculturation included in the model were: birthplace (continental US/not continental US), and the language index score described previously (range from 1 = Only English to 5 = Only Spanish). Proc LOGIST[1] accounts for sample weights but not design effects;[22] therefore standard errors were corrected for a design effect of 1.5 when calculating p-values and confidence limits.

Multivariate analysis to test interactions between acculturation measures and sociodemographic variables: For each Hispanic group and drug, the model described above served as the basic model to which interaction terms were added and tested one at a time. The interaction terms tested were: language use by birthplace, language use by gender, language use by age, language use by income, language use by education, and language use by marital status. Interactions between language use and birthplace and language use and each of the sociodemographic variables in the model were tested individually.

Test of the final model with all interaction terms: A final model for each drug and Hispanic group—which included all sociodemographic variables, language use, place of birth and all significant interactions as determined in the previous step—was then tested. Language use as a measure of acculturation rather than birthplace was chosen for the interactions because preliminary analyses showed this variable to be most closely associated with drug use.

Results

Sample Characteristics

Table 1 presents selected weighted sample characteristics for each Hispanic group. With the exception of the Puerto Rican sample, which was predominantly female, gender representation was approximately equal. Since drug use patterns have been shown to vary substantially by gender, the overrepresentation of females in the Puerto Rican sample of the HHANES needs to be considered in the interpretation of the findings. The Mexican American and Puerto Rican samples were younger, had a lower yearly family income, and have less formal education than the Cuban American sample. The Puerto Rican sample had a greater proportion of individuals who were unemployed and not currently married compared to the other Hispanic samples. Nearly 60 percent of Mexican Americans were born in the United States mainland, while this was true for only 21 percent of Puerto Ricans and 2 percent of Cuban Americans. Scores on the language use index indicate that Cuban Americans used Spanish more than English, Puerto Ricans were equally divided in language use, and Mexican Americans used English more than Spanish.

Drug Use

Age-adjusted rates for marijuana use: The age-adjusted rates shown in Table 2 indicate that nearly half of Mexican American and Puerto Rican men reported having used marijuana at some point in their lives, while 30.7 percent of Cuban American men reported ever using marijuana. Use of marijuana in the previous year among Hispanic men was reported by 26.6 percent of Puerto Ricans, 22 percent of Mexican Americans, and 12.5 percent of Cuban Americans.

Lifetime use of marijuana was reported by 30.8 percent of Puerto Rican women, but only 19.5 percent of Mexican American women and 11.5 percent of Cuban American women. Compared to lifetime use, use of marijuana in the previous year was reported by fewer women than men in all Hispanic groups. Compared to Mexican American (6.6 per-

TABLE 1—Selected Weighted Sample Characteristics of Hispanic Subgroup

Characteristics	Mexican American (N = 3,303)	Puerto Rican (N = 1,209)	Cuban American (N = 858)
	%	%	%
Sex			
Female	50.3	62.7	44.5
Male	49.7	37.3	55.5
Age (years)			
20–29	36.9	32.2	18.8
30–39	27.8	27.4	21.8
40–44[a]	7.5	11.4	10.7
45–49	6.9	8.8	10.9
50+	20.9	20.3	37.8
Yearly family income			
<$20,000	64.6	70.0	57.7
≥$20,000	35.4	30.0	42.3
Employed	62.2	47.6	67.5
Education (years)			
<8	33.7	21.3	27.2
8–11	24.4	31.5	19.0
12	23.8	29.5	23.7
>12	18.1	17.8	30.2
Marital status			
Never married	14.5	23.4	12.6
Married	72.0	51.6	69.3
Sep/Div/Wid	13.5	25.0	18.1
US-born[b]	59.3	21.5	2.3
Language use			
English only	25.2	18.2	4.0
Mostly English	30.3	24.0	7.9
Both equally	12.0	17.4	19.9
Mostly Spanish	19.7	31.2	42.7
Spanish only	12.9	9.2	25.6

a) The age category of 40–49 years is split into two groups because the questions on cocaine use were asked only of respondents ages 20–44.
b) Refers only to individuals born in the continental US.

TABLE 2—Age-adjusted Rates of Drug Use among Hispanic Men and Women (95 percent confidence intervals)

	Mexican American	Puerto Rican	Cuban American
Marijuana	%	%	%
Males	(N = 1,450)	(N = 440)	(N = 373)
Previous year	22.0	26.6	12.5
	(19.2, 24.8)	(21.9, 31.3)	(5.9, 19.1)
Lifetime	48.8	49.5	30.7
	(45.6, 52.0)	(41.3, 57.7)	(24.5, 37.0)
Females	(N = 1,853)	(N = 769)	(N = 485)
Previous year	6.6	12.5	3.8
	(4.7, 8.5)	(9.8, 15.2)	(1.2, 6.4)
Lifetime	19.4	30.8	11.5
	(15.8, 23.0)	(26.9, 34.7)	(5.5, 17.5)
Cocaine			
Males	(N = 903)	(N = 231)	(N = 141)
Previous year	10.8	26.9	17.1
	(7.6, 14.0)	(18.7, 35.1)	(7.5, 26.7)
Lifetime	19.6	40.6	20.3
	(14.6, 24.6)	(32.0, 49.2)	(8.8, 31.8)
Females	(N = 1,151)	(N = 442)	(N = 207)
Previous year	2.1	13.6	2.7
	(0.8, 3.5)	(9.8, 17.4)	(0.0, 5.4)
Lifetime	6.4	21.2	7.2
	(4.9, 7.9)	(16.5, 25.9)	(4.3, 11.0)

cent) and Cuban American women (3.8 percent). Puerto Rican women reported the highest rate of marijuana use (12.5 percent) in the previous year.

Age-adjusted rates for cocaine use: The age-adjusted rates for lifetime cocaine use indicate that 40.6 percent of all Puerto Rican men reported ever using cocaine and 26.9 percent reported using cocaine in the previous year. Among Mexican American men, 19.6 percent reported ever using cocaine and 10.8 percent reported using cocaine in the previous year. One-fifth (20.3 percent) of Cuban American men reported ever using cocaine and 17.1 percent said they used cocaine in the previous year.

Among women, 21.2 percent of all Puerto Rican women reported lifetime use of cocaine, while 6.4 percent of Mexican American and 7.2 percent of Cuban American women reported ever using cocaine. Use of cocaine in the previous year was reported by 13.6 percent of Puerto Rican women but only 2.1 percent of Mexican American and 2.7 percent of Cuban American women.

Marijuana and cocaine use by place of birth and language use: Figures 1 through 4 present the estimates of use and 95 percent confidence intervals (CI) for marijuana and cocaine use in the previous year by birthplace and language index. Use of marijuana and cocaine was reported more often by US-born Hispanic men and women of all groups than by those who were born outside the continental US (see Figures 1 and 2). Overall, the use of marijuana and cocaine use was highest among English-speaking Hispanic men and women than among those who were bilingual, who in turn were generally more likely to report drug use than those who were primarily Spanish-speakers (see Figures 3 and 4). As found in earlier analyses, in comparison to the other Hispanic groups, Puerto Rican men and women reported the highest use of marijuana and cocaine across language categories and birthplace. It should be noted, however, that sample sizes become very small, especially where drug use among Cuban Americans was reported by birthplace and language use, making these estimates highly unstable.

Multivariate Analysis

Table 3 presents odds ratios of socioeconomic and acculturation variables for use of marijuana and cocaine in the previous year among Mexican Americans and Puerto Ricans. The Cuban American sample of users was too small to conduct multivariate analysis. The odds ratios were

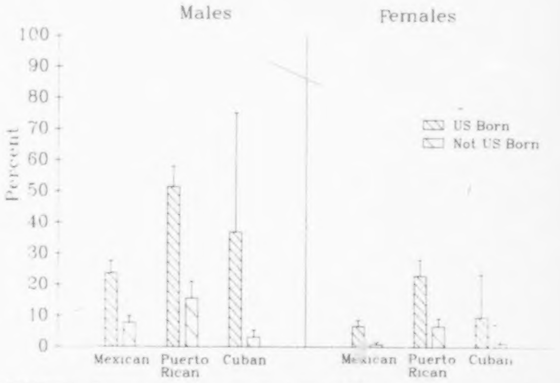

FIGURE 1—Percent of Mexican American, Puerto Rican, and Cuban American males and females who reported using marijuana in the previous year by birthplace
NOTE: Only upper 95 percent confidence limits are presented. The upper and lower limits are equidistant.

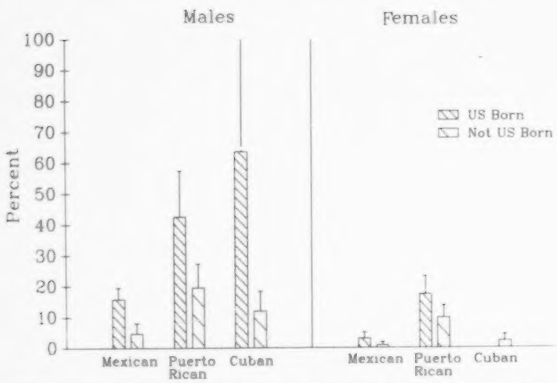

FIGURE 2—Percent of Mexican American, Puerto Rican, and Cuban American males and females who reported using cocaine in the previous year by birthplace NOTE: Only upper 95 percent confidence limits are presented. The upper and lower limits are equidistant.

developed with separate multivariate logistic regressions for each ethnic group/drug combination.

Marijuana Use

Marijuana use and acculturation effects: In both Mexican Americans and Puerto Ricans, language use was significantly associated with marijuana use in the previous year, even after sociodemographic factors were considered. The odds of using marijuana were eight times greater for Mexican Americans and five times greater among Puerto Ricans who were English-speaking than among Spanish-speakers.

Marijuana use and interaction effects: A final model, which included the significant interactions (see Methods) in addition to the basic model presented in Table 3, was tested separately for Mexican Americans ($\chi^2 = 611.84$, df = 12, $p < .0001$) and Puerto Ricans ($\chi^2 = 236.78$, df = 10, $p < .0001$).

Among Mexican Americans, marijuana use in the previous year was often reported by those who were younger ($p < .0001$), not employed ($p < .05$), separated/divorced/widowed ($p < .0002$), and never married ($p < .03$). In addition, significant interactions between language and sex ($p < .02$), language and education ($p < .05$), and language and never-married status ($p < .03$) were found. These interactions suggest that among Mexican Americans, speaking English was *more* strongly associated with a higher rate of marijuana use in the previous year among: women in comparison to men; those who have less formal education in comparison to those with more formal education; and those who were married compared to those who were not married.

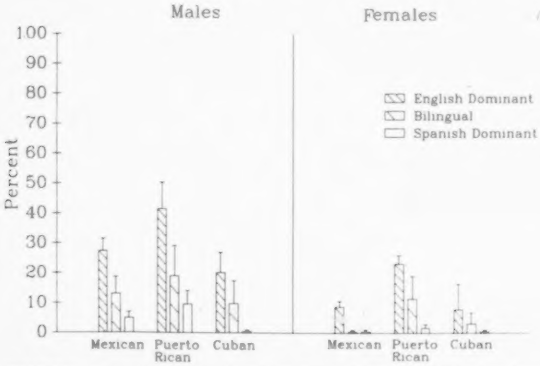

FIGURE 3—Percent of Mexican American, Puerto Rican, and Cuban American males and females who reported using marijuana in the previous year by language use.
NOTE: Only upper 95 percent confidence limits are presented. The upper and lower limits are equidistant.

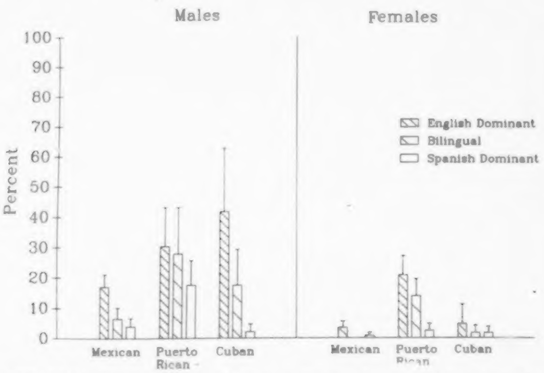

FIGURE 4—Percent of Mexican American, Puerto Rican, and Cuban American males and females who reported using cocaine in the previous year by language use.
NOTE: Only upper 95 percent confidence limits are presented. The upper and lower limits are equidistant.

Among Puerto Ricans, marijuana use in the previous year was most often reported by males ($p < .0001$), young adults ($p < .0001$), individuals with less education ($p < .05$), and those who were predominantly English-speaking ($p < .02$). One marginally significant interaction (language by education, $p < .08$) suggests that use of English among Puerto Ricans was *more* strongly associated with a higher rate of marijuana use in the previous year among those with less education than among those with more education.

Cocaine Use

Cocaine use and acculturation effects: Once sociodemographic variables were taken into account, language use was significantly associated with use of cocaine in the previous year among both Mexican Americans and Puerto Ricans (Table 3). The odds of using cocaine were 25 times greater among Mexican Americans who scored toward the English-dominant end of the language use index than among those who were Spanish-dominant. Among Puerto Ricans, English-speakers were two times more likely than were Spanish-speakers to report cocaine use in the previous year, but the association was weak.

Cocaine use and interaction effects: A final model, which included the basic model presented in Table 3 in addition to all significant interactions, was tested separately for Mexican Americans ($\chi^2 = 257.22$, df = 11, $p < .0001$) and Puerto Ricans ($\chi^2 = 158.29$, df = 12, $p < .0001$).

Among Mexican Americans, cocaine use in the previous year was most likely to be reported by those who were: male ($p < .0001$), young adults ($p < .0001$), less educated ($p < .002$), separated, divorced or widowed ($p < .006$), English-speakers ($p < .0001$), and born in the US ($p < .005$). Two significant interactions between language and birthplace ($p < .001$) and language and education ($p < .001$) suggest that use of English was *more* strongly associated with a higher rate of cocaine use among Mexican Americans who were US-born

TABLE 3—Odds Ratios (95 percent confidence intervals) of Socioeconomic and Acculturation Variables for Use of Marijuana and Cocaine in the Previous Year among Mexican Americans and Puerto Ricans, Multivariate Logistic Regressions

	Mexican Americans		Puerto Ricans	
	Marijuana	Cocaine	Marijuana	Cocaine
Variables	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sex				
Male vs. female	7.17 (4.78, 10.75)	7.52 (4.11, 13.77)	3.14 (1.93, 5.11)	2.66 (1.58, 4.49)
Age				
20 vs 40 years	8.33 (5.21, 13.32)	6.44 (2.74, 15.15)	6.03 (3.26, 11.15)	9.17 (3.63, 23.16)
Yearly Family Income				
<$20K vs ≥$20K	1.15 (0.81, 1.63)	0.75 (0.47, 1.20)	0.67 (0.40, 1.13)	0.65 (0.36, 1.17)
Employment				
Employed vs not	0.66 (0.45, 0.98)	0.94 (0.53, 1.67)	1.21 (0.72, 2.02)	1.98 (1.12, 3.50)
Education				
8 vs 16 years	0.79 (0.48, 1.29)	1.24 (0.60, 2.54)	0.91 (0.43, 1.91)	0.95 (0.42, 2.16)
Marital Status				
Sep/div/wid vs married	2.53 (1.54, 4.15)	2.75 (1.37, 5.51)	1.68 (0.89, 3.18)	3.70 (2.03, 6.74)
Single vs married	0.84 (0.56, 1.26)	1.14 (0.67, 1.95)	1.10 (0.62, 1.94)	2.55 (1.37, 4.75)
Birthplace				
US vs not US	1.54 (0.75, 3.17)	1.03 (0.50, 2.14)	1.44 (0.83, 2.49)	0.92 (0.37, 2.31)
Language Use				
English vs Spanish	8.62 (3.40, 21.88)	25.44 (6.56, 98.68)	5.32 (1.83, 15.46)	2.19 (0.69, 6.95)
ChiSquare	472.02	198.98	306.71	123.57
p	.0001	.0001	.0001	.0001

than among those who were Mexican-born and among those who had low educational attainment than among those with high educational attainment.

Among Puerto Ricans, cocaine use in the previous year was reported most often by those who were young adults ($p < .0001$), employed ($p < .04$), separated, widowed or divorced ($p < .0001$), never married ($p < .005$), and born in the US mainland ($p < .05$). Significant interactions between language and birthplace ($p < .04$) and language and sex ($p < .005$) suggest that greater use of English was *more* strongly associated with a higher rate of cocaine use among men than among women and among Puerto Ricans born on the island than those born on the US mainland. In addition, a marginally significant interaction between language and education ($p < .07$) suggests that the use of English was *more* strongly associated with cocaine use among Puerto Ricans of low educational attainment than those with higher educational attainment.

Discussion

The results indicate that the rate of marijuana and cocaine use among Hispanics, especially among Puerto Ricans, is higher than that for non-Hispanic Whites.[3] Because previous large-scale studies have not distinguished between the three largest Hispanic groups, the higher rates of drug use among Puerto Ricans may have been diluted by combining them with other Hispanics, who have drug use rates similar to those reported for non-Hispanic Whites.

It is possible that the higher rates of drug use among Puerto Ricans compared to other Hispanic groups reflect regional patterns of drug use. Some support for this interpretation is found in the data from the National Household Survey,[3] in which prevalence of lifetime and previous year marijuana and cocaine use was highest among those living in the Northeast region of the US. However, the lifetime and previous year rates for cocaine use among Puerto Ricans in the HHANES were higher than those reported in the general population of the US Northeast corridor. For example, data from the National Household Survey indicate that 8 percent of women, and 18 percent of men in the general Northeast population have used cocaine at some point in their lives. These rates were much lower than those estimated for Puerto Ricans from the HHANES (21.2 percent and 40.6 percent, respectively). Comparisons of estimates for use of cocaine in the previous year follow a similar pattern, suggesting that use of cocaine cannot be attributed solely to the geographic location.

The results also indicate that acculturation into US society, as reflected by language use, was accompanied by a higher prevalence of illicit drug use. This relationship holds true even when sociodemographic variables are taken into account. Yet, the relative strength of the association between acculturation measures and drug use varied across Hispanic subgroup and by drug. While the cross-sectional design of this study does not allow for an analysis of the process of acculturation, the results lead us to believe that it is important to develop research to further investigate the nature of the acculturation process among Hispanic subgroups and its relationships to drug use.

One possible factor which influences the impact of acculturation on drug use is the social context of drug use in the native country. For example, it is possible that drug availability and norms in Puerto Rico are closer to those in the US mainland than to those in Mexico or Cuba. This interpretation is supported by previous reports of drug use in Puerto Rico.[23,24] Thus, in order to better understand the factors which impact drug use among Hispanics living in the US mainland, research is needed on social norms and drug use practices in the countries from which Hispanics originate.

The results also suggest that the relation of acculturation to drug use differs across education levels. Acculturation, as measured by language use, had the strongest relation to drug use among those who were least educated. Mexican Americans and Puerto Ricans who were highly acculturated, but had not enjoyed access to educational resources of American society, were most likely to report marijuana and cocaine use. Similar findings indicating that high acculturation is associated with alcohol use among poor Hispanic men have been reported in the literature.[17,25,26] Acculturation, when accompanied by poverty and/or lack of access to education, may resemble what Berry termed "marginalization."[27] In this type of acculturation, an individual loses essential features of his/her culture and at the same time has not entered the larger society. This type of acculturation results in feelings of alienation and loss of identity, is highly stressful, and places an individual at high risk for poor mental health outcomes.[27]

Our findings also suggest that, in some cases, the relationship of acculturation to drug use varies by sex. Once socioeconomic factors were considered, the gender gap in marijuana use was relatively small among Mexican Americans who speak primarily Spanish. This contrasts with the rates of drug use among those who were predominantly English-speaking, for whom the rates were much higher among men than among women. Yet, the relative difference in drug use between Spanish- and English-speakers was larger among women than men. This finding is consistent with reports in the alcohol literature, which suggest that acculturation is more strongly associated with alcohol use among Mexican American women than among Mexican American men.[16,17] However, among Puerto Ricans, acculturation was more strongly associated with cocaine use among men than among women. The findings indicating that acculturation is differentially associated with drug use across educational levels and gender leads us to suspect that acculturation, as it relates to drug use, is integrally affected by the social and economic context in which an individual becomes socialized and lives. The impact of gender roles and educational attainment on drug use and their relation to acculturation among Hispanics deserves empirical investigation.

HHANES, although the first large scale survey to provide information on drug use among various Hispanic groups in the US, is limited in several ways. First, the measures of acculturation used in the HHANES were developed for Mexican Americans and not for Puerto Ricans and Cuban Americans. Second, measures of drug use employed in the HHANES do not allow assessment of the degree or context of drug use or the impact of drug use on functioning. Third, the HHANES employed self-reported measures of drug use, which are vulnerable to multiple threats to validity.[28] Respondents tend to underepon socially undesirable behaviors. What is deemed undesirable behavior may differ among women and men and among those who are not acculturated compared to those who are highly acculturated. If gender roles and culture determine norms regarding drug use, then the validity of self-reported drug use may also vary by these factors. Even with these limitations, the findings have important implications for the study of drug use among Hispanics because they provide evidence of a relationship between acculturation and illicit drug use. The findings also underscore the need for a better understanding of the process of acculturation among Hispanics and other immigrant groups.

The present findings also indicate the need for further studies of drug use among Hispanics, especially Puerto Ricans on the mainland and on the island. Because of the close political, economic, and legal ties between Puerto Rico and the United States mainland, and because of the continuous migration to and from Puerto Rico, drug availability and norms of drug use in the continental US may have a direct effect on drug use among Puerto Ricans living on the island. Yet, Puerto Rico is not usually included in national studies of drug use, leaving a critical gap in knowledge about a substantial Hispanic population in the US. Further, public education campaigns and prevention efforts to reduce initiation into drug use have not typically included Puerto Ricans on the island. Policy initiatives are needed to develop and implement prevention programs aimed at the Puerto Rican population on both the island and in the mainland. Such initiatives should include ongoing mechanisms for gathering information on drug use among Puerto Ricans.

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X. Generational Differences in Perinatal Health among the Mexican American Population: Findings from HHANES 1982–84

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Abstract: Data from the Hispanic Health and Nutrition Examination Survey (HHANES) were used to examine a profile of social, medical, and behavioral characteristics associated with low birthweight (LBW) and miscarriages in first and second generation Hispanics of Mexican descent. The percentage of LBW was 5.3 and of miscarriages was 12.7. LBW rates were higher for second generation primipara and multipara compared with first generation women. Using multivariate logistic regression techniques and adjusting for complex design effects, generation was found to be a significant predictor of LBW but not of miscarriages. The findings support existing evidence that a Mexican cultural orientation protects first generation, Mexico-born women against a risk for LBW. However, the findings do not show significant effects of generation on miscarriages, suggesting that cultural effects are not consistent for all pregnancy outcomes. Furthermore, we suggest that the higher rates of LBW in second generation women are not due to a higher rate of miscarriages as has been hypothesized. [*Am J Public Health* 1990; 80(Suppl):61–65.]

Introduction

The Mexican-origin population in the United States has been growing sharply since 1970, largely as a result of high fertility rates and immigration. Despite the high birth rates of Hispanic women, little is known about their perinatal outcomes and their associated risk factors. Existing evidence, mainly derived from birth and death certificates, suggests that Mexican-origin women have birth outcomes similar to those of White non-Hispanic populations.[1-9]

Recent findings also suggest that birth outcomes are more favorable among first generation women born in Mexico than among second or successive generations of US-born women of Mexican descent. According to a 1985 nationwide study, only 5.0 percent of the infants of Mexico-born mothers were of low weight, compared to 6.3 percent of infants of US-born Mexican origin mothers and 5.7 percent of white non-Hispanic mothers.[7] Similar differential rates by birthplace have been found in California, the state with the largest concentration of Mexican descendants,[1] and most recently by Scribner and Dwyer[10] in a study of the Hispanic Health and Nutrition Examination Survey (HHANES).

The lower rates of low birthweight (LBW) of first generation mothers is intriguing and difficult to explain according to evidence derived from birth certificates.[1,4-7] Compared to US-born mothers of Mexican descent, foreign-born, first generation women have a lower socioeconomic status, a higher percentage of women over 35 years of age, and less adequate prenatal care.[2-4] On the basis of these risks, one would expect first generation mothers to have an increased risk of LBW. Recent evidence from the HHANES challenges this assumption. According to Scribner and Dwyer women with a Mexican cultural orientation have a reduced risk of LBW, even after controlling for sociodemographic characteristics and smoking.[10] A Mexican orientation serves as a marker for a lifestyle that is protective against the negative influences on pregnancy outcomes.[10,11]

A few other studies have suggested that the lower LBW rate in Mexico-born women may be related to a high rate of miscarriages which eliminate weaker fetuses.[12,13] Approximately 10 percent to 15 percent of pregnancies identified by conventional criteria end in clinically recognizable spontaneous abortions.[14] Miscarriage/stillbirth rates for Mexican American farmworkers range from 24 percent to 31 percent, depending on the target population and method of ascertainment.[15,16]

In this study, we use the HHANES data base to examine the acculturation and miscarriage hypotheses regarding more favorable LBW rates in Mexico-born compared with US-born women of Mexican origin. For this purpose we first explore a wide array of social, behavioral, and medical variables associated with LBW and miscarriages in first and second generation women of Mexican descent. We subsequently investigate the effects of generation on LBW, controlling for social, behavioral, and medical factors in separate predictive models for primipara and multipara. The use of separate models is based on findings by Eisner, *et al*,[17] indicating that multipara have a lower percent LBW than primipara and different factors predict LBW in each group. Finally, controlling for the other maternal characteristics in a multivariate regression model, we examine whether generational status also has an effect on miscarriages.

Methods

Sample

Data were obtained from the Medical History section of the HHANES which is a health survey conducted in 1982–84 of three Hispanic sub-populations (Mexican American, Puerto Rican, Cuban American)[18] living in selected areas of the United States.[18] The survey contains information on approximately 8,500 Mexican Americans residing in the southwestern US. Representatives were selected using a multistage, stratified area probability sample of households and residential clusters. All adult women of Mexican birth or origin, were initially included in this study if they were interviewed in the household and examined in a mobile examination unit and were between the ages of 16 and 55. We excluded women over age 55 due to concerns regarding recall accuracy. Out of 1,518 participants, 128 (8.4 percent) were excluded due to missing values of LBW, miscarriages, and/or generation which are the key variables of interest. Thus the final analytic sample consisted of 1,390 respondents.

Definition of Variables and Data Analysis Technique

Our two outcome variables are a history of LBW and of miscarriages (0 = no; 1 = yes) derived from the following HHANES questions:

- For *multipara*, "How many of your children (who were born alive) weighed less than 5½ pounds (2,500

Note: Author affiliations are listed elsewhere under CONTRIBUTORS.

grams) at birth?" and "What is the total number of live births you have had?"

- For *primipara*, "Did this (the only) child weigh less than 5½ pounds (2,500 grams) at birth?"
- Other questions asked of *all women* were "What is the total number of miscarriages you have had?" and "How many times have you been pregnant?"

Generation, which is determined by the birthplace of the subjects, was selected as the primary independent variable. To allow for sufficient sample size, the original three-generation coding given in the data tape (first generation born in Mexico; second generation not born in Mexico, one or both parents born in Mexico; third or higher generation, neither parent born in Mexico) was collapsed into two groups: 1) subjects born in Mexico whose parents were born outside the US, and 2) subjects born in the US who had at least one parent born in Mexico or of Mexican descent.

Other social, behavioral, and medical variables were initially screened if they have been reported in the literature as significantly related to birthweight or miscarriages in non-Hispanic populations.[19,14] Only those variables that were at least moderately associated ($p \leq .20$) with LBW in pairwise analyses and/or with miscarriages in separate pairwise analyses (adjusting for number of live births and number of pregnancies, respectively) were included for further study.

The *social variables* considered in the predictive models for LBW and miscarriages are: 1) Medicaid coverage in the last 12 months prior to the interview; 2) highest grade of regular school completed; 3) family income which is the combined income obtained in the last 12 months from jobs, public assistance, rents, interests or other sources; 4) marital status which refers to whether a spouse is living in the home; and 5) age in years at the time of the interview.

The *behavioral factors* are: 1) current drinker status determined by asking of non-abstainers whether they have had a drink in the last 28 days; 2) current smoker status determined by the question "Do you currently smoke cigarettes?"; and 3) interval, in years, since the last Pap smear test, recoded into four ordinal categories ranging from last two weeks to never.

Medical factors include: 1) self-reported physician-diagnosed blood pressure or hypertension; 2) Quetelet index, i.e., a body mass index based on self-reported weight at age 25 and height (weight/height^2). On the basis of the pairwise analyses described above, three additional variables were included in the model for miscarriages, namely: self-reported physician diagnosed diabetes, heart problems, and self-perceived health status ranging from very good to poor.

Differences between the two generational groups for each independent and outcome variable were examined by performing Student's two sample t-tests for the continuous variables and chi-square tests for the categorical variables. Since the HHANES is a multistage, stratified probability sample of clusters of persons in area-based segments,[18] estimates were weighted using the "examined weights" and complex design effects were taken into account using the Super Carp program.[20] To facilitate presentation, only the weighted values and statistics are presented in the generational profile in Table 1.

Logistic regression was used (SAS Logist procedure)[21] to examine the effects of generation on each outcome variable controlling for the social, medical, and behavioral factors studied. Only cases which had complete information on all these variables were included in the analyses (n = 1,078). We ran simultaneous logistic regressions for all women and then separate models for primipara and multipara. From these results we estimated odds ratios and their 95 percent confidence intervals. For continuous or ordinal predictors, standardized odds ratios are estimated. These are presented in Tables 2–5. To check whether the statistical significance of some variables might be affected by collinearity with other variables, the simultaneous logistic procedure was followed

TABLE 1—Maternal Characteristics by Generation for Hispanic Women, HHANES 1982–84

	First Generation			Second Generation and Beyond			
Characteristics	N = 543	Weighted Mean or %*	S.E.	N = 847	Weighted Mean or %*	S.E.	p**
Social							
Education, M in years	543	M = 7.1	0.2	847	M = 10.6	0.3	.000
Income, M in $1,000 increments	543	M = 14.1	0.3	847	M = 15.8	0.4	.009
Medicaid last 12 months	541	5.9%	1.4	842	8.6%	1.1	.168
Married	541	75.8%	2.3	847	70.0%	2.0	.094
Age, M in years	543	M = 34.1	0.5	847	M = 34.3	0.4	.763
Live births, M number	543	M = 3.3	0.8	847	M = 3.1	0.4	.827
Behavioral							
Current smoker	528	21.1%	1.3	798	28.1%	1.6	.009
Current drinker	542	6.0%	1.0	847	12.4%	1.3	.005
Never had a Pap smear	538	11.1%	1.3	832	3.3%	1.1	.002
Biological							
History of high blood pressure	543	21.4%	2.2	847	22.4%	1.9	.740
Quetelet index at age 25	446			801			
Low Quetelet index		30.8%	1.6		28.6%	1.4	.517
Medium Quetelet index		56.8%	2.3		55.7%	1.7	
High Quetelet index		12.5%	2.3		15.7%	2.7	
History of diabetes	543	5.1%	0.5	847	8.0%	0.4	.002
History of heart problems	543	2.4%	0.6	846	4.8%	0.8	.043
Perceived health status, M	542	M = 3.28	0.03	847	M = 2.83	0.04	.000
Pregnancies, M number	543	M = 3.9	0.7	847	M = 3.7	0.6	.834

SOURCE: Hispanic Health and Nutrition Examination Survey, 1982–1984.
*Complex design effects also taken into account.
**p values represent the significance level for the first and second generation comparison in the weighted analysis.

up with a backwards stepwise regression.[21] Data in the models were weighted according to the scaled weighting procedure proposed by the National Center for Health Statistics, where the sum of the weights is equal to the observed sample size.[22] The results on Tables 2–5 were also examined adjusting for complex design effects using the estimated average design effect of 1.5 as described by Delgado, et al.[23]

Results

Generational Profiles of Maternal Characteristics

The two generational groups were similar with respect to age at interview (34.1 years for the first and 34.3 years for the second) and the proportion of primiparous women (19.7 percent in the first and 20.8 percent in the second). The findings in Table 1 indicate that a variety of significant changes take place between the first and second generation or beyond. Second generation women have a significantly higher educational attainment than first generation women. On the average they have 3½ more years of formal schooling. Family income is also significantly higher in the second generation despite the fact that, compared with the first generation, there are more women living without a spouse at home. From a behavioral standpoint, far more second generation women are smokers and drinkers than first generation women. However, significantly fewer second generation women have never had a Pap smear compared with those in the first. No significant differences in high blood pressure or Quetelet index were found between the two generations, but second generation women had significantly higher proportions of physician-diagnosed diabetes and heart problems. Despite reporting more medical problems, second generation women perceived their health status significantly better than first generation women.

Generational Effects on Low Birthweight

The percentage of low birthweight out of the total live births for Mexican origin mothers is 5.3 (S.E. = 0.04). This estimate is similar to the rates based on birth certificate data reported by Williams[1] (5.3 percent) and Ventura[5] (5.6 percent) and higher than those reported by Scribner and Dwyer[10] (4.8 percent) using an HHANES sample of older women up to age 74. Similar to Scribner and Dwyer, we found that LBW rates differ significantly for the two generational groups. Out of the total live births for the first generation 3.9 percent (S.E. = 0.7) are of LBW, whereas out of the total live births for the second generation, 6.1 percent (S.E. = 0.7) are of LBW. The generational effects on LBW are significant, even after adjusting, in a logistic regression model, for the social, behavioral and medical characteristics. The risk of LBW is 1.73 times higher (95% CI = 1.11, 2.71) in the second generation compared with the first (Table 2). This result remains significant even after adjusting for complex design effects.

We examined the generational differences in birthweight outcomes in the two parity groups and found that, in the first generation, the LBW rate was 6.3 percent (S.E. = 1.8) in primipara and 3.8 percent (S.E. = 0.05) in multipara. In the second generation, primipara also had higher rates: 9.7 percent (S.E. = 2.4) compared with 5.9 percent (S.E. = 0.06) in multipara. These estimates indicate that although the percentage of LBW increases in the second generation, in both generations primipara have LBW rates that are almost 1.5 times higher than multipara.

TABLE 2—Adjusted Odds Ratios[+] for Low Birthweight (n = 1078)

Variables	Adjusted Odds Ratios[*]	95% CI
Generation (0 = first, 1 = second or beyond)	1.73	1.11, 2.71
Number of live births	1.37	1.13, 1.67
Age at interview	1.13	0.91, 1.41
Marital status (0 = no spouse home; 1 = spouse at home)	0.92	0.58, 1.47
Years of education	0.93	0.75, 1.15
Income	0.93	0.75, 1.14
Medicaid coverage (0 = no; 1 = yes)	0.83	0.39, 1.78
Current drinker status (0 = abstainer; 1 = drinker)	0.76	0.41, 1.40
Current smoker status (0 = no; 1 = yes)	1.58	1.05, 2.38
Interval since last Pap smear	1.01	0.84, 1.21
Low Quetelet index at age 25 (0 = no; 1 = yes)	1.46	[**]
High Quetelet index at age 25 (0 = no; 1 = yes)	1.26	
History of high blood pressure (0 = no; 1 = yes)	1.25	0.82, 1.91

SOURCE: Hispanic Health and Nutrition Examination Survey; 1982–84

[+] Logistic regression analysis techniques were used to obtain the adjusted odds ratios.

[*] For the continuous and ordinal variables, live births, age at interview, education, income and interval since last pap smear, standardized odds ratios are presented. (The odds ratio of LBW for the increase of one standard deviation of the predictor.)

[**] To evaluate the Quetelet index (a nominal variable with 3 categories), a X^2 test statistic with 2 D.F. was obtained from the difference of two log likelihood functions and was found to be not statistically significant.

TABLE 3—Adjusted Odds Ratios[+] for Low Birthweight among Primiparous Women (n = 187)

Variables	Adjusted Odds Ratios[*]	95% CI
Generation (0 = first, 1 = second or beyond)	4.08	0.81, 20.45
Age at interview	0.97	0.53, 1.77
Marital status (0 = no spouse home, 1 = spouse at home)	1.23	0.31, 1.51
Years of education	0.98	0.51, 1.91
Income	1.32	0.68, 2.59
Medicaid coverage (0 = no; 1 = yes)	0.30	0.02, 4.18
Current drinker status (0 = abstainer; 1 = drinker)	0.93	0.78, 1.11
Current smoker status (0 = no; 1 = yes)	0.62	0.16, 2.43
Interval since last Pap smear	1.87	1.09, 3.20
Low Quetelet index at age 25 (0 = no; 1 = yes)	1.28	[**]
High Quetelet index at age 25 (0 = no; 1 = yes)	1.06	
History of high blood pressure (0 = no; 1 = yes)	5.07	1.59, 16.20

SOURCE: Hispanic Health and Nutrition Examination Survey; 1982–84

[+] Logistic regression analysis techniques were used to obtain the adjusted odds ratios.

[*] For the continuous and ordinal variables, standardized odds ratios are presented.

[**] To evaluate the Quetelet index (a nominal variable with 3 categories), a χ^2 test statistic with 2 D.F. was obtained from the difference of two log likelihood functions and was found to be not statistically significant.

As shown in Table 3, we found that after adjusting for the potential confounders included in the logistic regression model, the risk of LBW is approximately four times higher for second than first generation primiparous women (OR 4.08; 95% CI = 0.81, 20.45). The risk factor, however, was not statistically significant at the p = .05 level, possibly due to small sample size. The risk for LBW is five times higher for primiparous women with a physician-diagnosed history of high blood pressure (OR 5.07; 95% CI = 1.59, 16.20) and it almost doubles when the interval since last Pap smear is greater than one standard deviation from the mean (OR 1.87; 95% CI = 1.09, 3.20). After adjusting for complex design effects, the only significant predictor that remained was blood pressure.

The effect of generation on LBW was significant for multiparous women. The findings in Table 4 show that the risk of LBW is almost double for second generation women (OR 1.69; 95% CI = 1.05, 2.84) and for current smokers (OR 1.79; 95% CI = 1.16, 2.76). Smoking remained a significant predictor even after adjusting for complex design effects. Results similar to those obtained with the logistic regression techniques were obtained when doing backwards stepwise regressions for primipara and multipara.

Generational Effects on Miscarriages

The percentage of miscarriages out of the total number of pregnancies for Mexican origin mothers is 12.7 percent (S.E. = 0.59). This rate falls within the expected range for spontaneous abortions in the mainstream population.[14] Furthermore, the rates for the two generational groups are not significantly different. Out of the total number of pregnancies for the first generation, 13.1 percent (S.E. = 0.99) have had miscarriages. For the second generation the percentage of miscarriages is 12. 5 percent (S.E. = 0.60).

Using logistic regression, we examined whether generation becomes a significant predictor of miscarriages after adjusting for the social, behavioral and medical factors listed in Table 5. Generation was not a significant predictor of miscarriages (OR 0.81; 95% CI = 0.57, 1.15). The adjusted odds ratios reported in Table 5 indicate that miscarriages increase 1.25 times with every increase in one standard deviation in education (95% CI = 1.04, 1.51); it increases 1.47 times (95% CI = 1.79, 1.22) with every decrease in one standard deviation in age and 1.43 times among women without a spouse living at home (95% CI = 2.13, 0.97). Education and age remained significant after adjusting for complex design effects.

Since Scribner and Dwyer[10] reported that generation was not as strong a predictor of pregnancy outcome as acculturation, we examined the role of acculturation in predicting miscarriages. Like Scribner and Dwyer, we looked at the effect of the acculturation index with and without including generation and found that it was not a significant predictor of miscarriages.

TABLE 4—Adjusted Odds Ratios[+] for Low Birthweight among Multiparous Women (n = 892)

Variables	Adjusted Odds Ratios[*]	95% CI
Generation (0 = first, 1 = second or beyond)	1.69	1.05, 2.84
Number of live births	1.37	1.11, 1.68
Age at interview	1.18	1.05, 1.33
Marital status (0 = no spouse home, 1 = spouse at home)	0.86	0.52, 1.44
Years of education	0.92	0.73, 1.16
Income	0.89	0.79, 1.11
Medicaid coverage (0 = no; 1 = yes)	0.97	0.43, 2.20
Current drinker status (0 = abstainer; 1 = drinker)	0.79	0.41, 1.52
Current smoker status (0 = no; 1 = yes)	1.79	1.16, 2.76
Interval since last Pap smear	0.89	0.72, 1.09
Low Quetelet index at age 25 (0 = no; 1 = yes)	1.46	**
High Quetelet index at age 25 (0 = no; 1 = yes)	1.38	
History of high blood pressure (0 = no; 1 = yes)	0.95	0.60, 1.51

SOURCE: Hispanic Health and Nutrition Examination Survey; 1982–84

[+] Logistic regression analysis techniques were used to obtain the adjusted odds ratios.

[*] For the continuous and ordinal variables, standardized odds ratios are presented.

[**] To evaluate the Quetelet index (a nominal variable with 3 categories), a χ^2 test statistic with 2 D.F. was obtained from the difference of two log likelihood functions and was found to be not statistically significant.

TABLE 5—Adjusted Odds Ratios[+] for Miscarriages (n = 1078)

Variables	Adjusted Odds Ratios[*]	95% CI
Generation (0 = first, 1 = second or beyond)	0.81	0.57, 1.15
Pregnancy number	3.92	3.09, 4.96
Age at interview	0.68	0.56, 0.82
Marital status (0 = no spouse home, 1 = spouse at home)	0.69	0.47, 1.03
Years of education	1.25	1.04, 1.51
Income	1.15	0.97, 1.37
Medicaid coverage (0 = no; 1 = yes)	0.96	0.52, 1.75
Current drinker status (0 = abstainer; 1 = drinker)	0.99	0.60, 1.61
Current smoker status (0 = no; 1 = yes)	1.11	0.78, 1.58
Interval since last Pap smear	0.91	0.78, 1.06
Low Quetclet index at age 25 (0 = no; 1 = yes)	1.13	**
High Quetelet index at age 25 (0 = no; 1 = yes)	0.96	
History of high blood pressure (0 = no; 1 = yes)	1.23	0.86, 1.76
History of diabetes (0 = no; 1 = yes)	1.25	0.70, 2.24
History of heart problems (0 = no; 1 = yes)	1.07	0.52, 2.20
Perceived health status	1.09	0.93, 1.29

SOURCE: Hispanic Health and Nutrition Examination Survey; 1982–84

[+] Logistic regression analysis techniques were used to obtain the adjusted odds ratios.

[*] For the continuous and ordinal variables, standardized odds ratios are presented.

[**] To evaluate the Quetelet index (a nominal variable with 3 categories), a χ^2 test statistic with 2 D.F. was obtained from the difference of two log likelihood functions and was found to be not statistically significant.

Nor was generation a significant predictor of miscarriages when logistic models were constructed separately for primipara and multipara (primipara: OR 0.76; 95% CI = 0.31, 1.87; multipara: OR 0.91; 95% CI = 0.62, 1.34). However, for primipara, an older age at interview (OR 1.74; 95% CI = 1.17, 2.57) and Medicaid coverage (OR 3.30 95% CI = .93; 11.69) was positively associated with miscarriages, whereas in multipara age and socioeconomic factors were inversely associated with miscarriages (age OR 0.64; 95% CI = 0.52, 0.78; income OR 1.17; 95% CI = 0.97, 1.42; education OR 1.22; 95% CI = 1.00, 1.49).

Discussion

The findings from this study show that for the Mexican origin population in the United States the percentage of LBW was 5.3 and the percentage of miscarriages was 12.7. Whereas the incidence of LBW in this population is lower than that for the general population, the rate of miscarriages seems similar to what is expected for the mainstream population.[5,8,14]

Mexican Americans are a heterogeneous group and our analysis demonstrates that wide variations are found according to generation and parity. US-born Mexican Americans are at 60 percent higher risk for LBW than Mexico-born women. Furthermore, the rate of LBW among US-born primipara at 9.7 percent begins to approximate that of the Black population.[19]

The findings, based on a rich array of variables, further demonstrate that across generations, significant changes take place in certain bio-social-behavioral characteristics of mothers which are associated with pregnancy outcomes (Table 1). While second generation Mexican American women show a higher educational and income status and more use of health care relative to their first generation counterparts, certain behavioral characteristics such as smoking and drinking behaviors actually deteriorate in the second generation. The second generation also has higher rates of physician-diagnosed diabetes and heart problems. However, this could be a result of improved access to care rather than to poor health status.

Our multivariate models indicate that generation is a significant predictor of LBW but not of miscarriages. This evidence points to two important findings: first, even after controlling for other factors, US-born Mexican origin women of the second generation or beyond have a higher likelihood of giving birth to LBW infants; and second, these patterns are not consistent for all pregnancy outcomes.

According to the acculturation model, the behaviors or lifestyles that protect women against adverse pregnancy outcomes are associated with a Mexican cultural orientation which predates pregnancy. If this were the case, we would have expected that generation (as a proxy for acculturation) would have been a significant predictor, not only of LBW but also of miscarriages. Evidence from this study does not support this conclusion. The findings show no significant effects of generation or the acculturation index on miscarriages. Rather than cultural factors, the results suggest that socioeconomic, genetic, and unaccounted medical factors are better predictors of miscarriages in Latinas.

Furthermore, the findings do not support the hypothesis that increased fetal losses explain the more favorable LBW outcomes in first generation Mexican-Americans.[12,13] The 13.1 percent miscarriage rate in the first generation was very similar to the 12.5 percent found in the second generation.

However, the possibility of reporting bias cannot be discounted in this study. Underreporting miscarriages among first generation women could occur as a result of less education which leads to less body awareness or less likelihood of recognition of miscarriages. Furthermore, compared with US-born, Mexico-born women are more likely to seek prenatal care late or none at all,[5] and thus are less likely to receive a medical diagnosis if miscarriages occur. Conversely, because induced abortion in Mexico is illegal, Mexico-born women could be misreporting induced abortion as miscarriages to make it more acceptable.[24] The possibility of measurement error also arises given the potential ambiguity concerning what events actually constitute a miscarriage. We suspect that miscarriages may be more prone to reporting bias than LBW, particularly among less educated women. Hence, further studies are needed to confirm the validity of the fetal loss hypothesis.

Because the HHANES is a cross-sectional, retrospective survey, variables do not necessarily measure the conditions or behaviors at the time of birth, hence possibly washing away some of the effects. In this study, the recall bias was as long as 40 years and no attempts at verifying the accuracy of the miscarriage or LBW information given to the mother at the time of delivery were made in the HHANES. Nevertheless, some of the traditional risk factors e.g. smoking for LBW and e.g. age for miscarriages are corroborated using the HHANES data. Furthermore, the results of LBW are consistent with those found by Williams, *et al*,[1] in California. The latter found that the lower rates of LBW among Mexico-born compared with US-born women of Mexican origin could not be the result of systematic underreporting by Mexican women.

In conclusion, the findings from the HHANES suggest that cultural explanations of differential pregnancy outcomes in women of Mexican origin must be restricted to LBW. The evidence strongly argues for the need to include generation as a risk factor when doing studies of LBW in Mexican-Americans. Further studies are also needed to assess the extent to which prematurity or intrauterine growth retardation determine pregnancy outcomes in each generation. This is a question that cannot be addressed in the HHANES.

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XI. The Prevalence of Total Tooth Loss, Dental Caries, and Periodontal Disease among Mexican Americans, Cuban Americans, and Puerto Ricans: Findings from HHANES 1982–1984

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Abstract: This paper describes the prevalence of total tooth loss, dental caries, and periodontal disease in 2,226 Puerto Ricans, 1,192 Cuban Americans, and 5,983 Mexican Americans, ages five to 74 years, who were examined during the 1982–84 Hispanic Health and Nutrition Examination Survey (HHANES). The prevalence of total tooth loss was 2.60, 6.10, and 2.80 percent among Mexican Americans, Cuban Americans, and Puerto Ricans, respectively. After adjusting for the confounding effects of age, sex, income, and education status, no statistically significant differences were found in the mean number of decayed teeth among the three groups of Hispanics. Puerto Rican children had an average of 2.09 filled teeth compared with an average of 1.39 and 1.43 filled teeth for Mexican Americans and Cuban Americans, respectively. In adults, Puerto Ricans and Cuban Americans had at least 40 percent higher mean number of filled teeth than Mexican Americans. Cuban American and Puerto Rican adults had about twice as many missing teeth as Mexican Americans. The pit-and-fissure tooth surfaces in children accounted for the majority of sites affected by caries.

All Hispanics had a higher prevalence of gingivitis than American adults as estimated during the 1985–86 National Institute of Dental Research (NIDR) survey of American adults. Puerto Ricans had the highest level of periodontal disease and the highest Debris Index scores among the Hispanic groups. [*Am J Public Health* 1990; 80(Suppl):66–70.]

Introduction

Dental public health practice in the United States is now facing new challenges. In addition to the political and economic changes that have affected public health programs in the last decade, there has been a significant increase in the numbers of the elderly and minorities, such as Hispanics.[1,2] As the proportion of minorities in the US increases, data on their oral health status will be needed to plan the treatment and preventive services required to meet their health needs.

Data from recent national surveys show a disturbing pattern of untreated dental caries in Blacks and Mexican Americans.[3–5] In the 1985–86 national survey conducted by the National Institute of Dental Research (NIDR),[3] Blacks had a higher mean number of decayed tooth surfaces than White non-Hispanics in all age groups between 18–19 and 60–64 years of age. The differences in mean numbers of decayed tooth surfaces between White and Black Americans ranged from 66 percent in adults 30–34 years of age to 419 percent in those 60–64 years of age. Despite the higher level of decayed teeth in Blacks, their mean number of permanent decayed and filled tooth surfaces (DFS) was lower than that of Whites, because of the lower mean number of filled teeth in Blacks. These differences between Black and White adults were similar to those found during the first National Health and Nutrition Examination Survey (NHANES I) conducted between 1971 and 1974,[6] where Blacks had a 93 percent higher mean number of decayed teeth than non-Hispanic Whites. In 1971–74, the latter had three times higher mean numbers of filled teeth than Blacks.

Information about the oral health status of Puerto Ricans, Cuban Americans, Mexican Americans, and other minorities in the United States is sparse. In a 1972–73 survey in New York City by Nikias and co-workers,[7] Puerto Ricans had a lower number of filled teeth than non-Hispanic Whites, but the mean number of filled teeth of Puerto Ricans was not different from that of Blacks. Non-Hispanic White New Yorkers had a lower mean number of decayed teeth than Blacks and Puerto Ricans. Puerto Ricans also had a higher level of gingival inflammation than non-Hispanic Whites and Blacks. Other geographically limited surveys of dental caries prevalence of Puerto Ricans and other Hispanics have reported similar findings.[8,9]

As described elsewhere in this supplement,[10] the National Center for Health Statistics (NCHS) responded to the lack of information on the health and nutritional status of Hispanics in the United States by conducting the Hispanic Health and Nutrition Examination Survey (HHANES) between 1982 and 1984. Previous reports described the prevalence of dental caries and periodontal disease of Mexican Americans living in five Southwestern states.[4,5] Dental data on Puerto Ricans and Cuban Americans became available for analysis in 1987. This report describes the prevalence of total tooth loss, dental caries, periodontal disease, and oral hygiene status in Cuban American and Puerto Rican children and adults, ages five years or older. Because of the small number of Cuban Americans and Puerto Ricans examined during HHANES compared with Mexican Americans, the age groups used in previous reports could not be used in this analysis.[4,5] Therefore, a re-analysis of the Mexican Americans' dental data was carried out in order to provide a comparison group to both Cuban Americans and Puerto Ricans.

Methods

A description of the HHANES sample design and data collected is presented elsewhere in this supplement.[10] Previous reports have summarized the criteria used during HHANES to measure the prevalence of dental caries, periodontal disease, and oral hygiene status.[4,5]

In this report, data will be presented for 5,983 Mexican Americans, 1,192 Cuban Americans, and 2,226 Puerto Ricans between the ages of five and 74 years with dental data. All those who identified themselves as Mexican Americans in Arizona, California, Colorado, New Mexico, and Texas; as Puerto Ricans in the New York City area; and as Cuban Americans in Dade County, Florida, were included in this study. Out of those medically examined, only 2.97, 1.25, and 2.36 percent of Mexican Americans, Cuban Americans, and Puerto Ricans, respectively, between six months through 74

Note: Author affiliations are listed elsewhere under CONTRIBUTORS.

years of age, did not receive a dental examination. Only the dental status of the permanent teeth is described in this paper.

All means, percentages, and regression coefficients presented were computed using sampling weights as described by Delgado and co-workers[10] and Landis, *et al.*[11] Also, adjustment for clustering effects was carried out when standard errors of the means, percentages, and regression coefficients were computed using the design effects provided by the NCHS and published in Public Use Data Tape Documentation (Dental Health, Tape number 6505). The dental variables used in the analysis were: total tooth loss; number of decayed, filled, and missing teeth (and tooth surfaces) for each individual; the Periodontal Index (PI) scores,[12] and periodontal classification based upon the PI score (no periodontal disease, gingivitis only, periodontal pockets) and Debris Index (DI) and Calculus Index (CI) scores for those with at least one tooth in their mouth.[13]

Differences in the dental status among the three Hispanics groups were considered present only if they remained after adjusting for the confounding effects of age, sex, income, and education. Multiple linear regression analysis was used during adjustment when continuous variables were compared, and logistic regression analysis was used when a dichotomous variable was the dependent variable. This approach was used because of the differences among the three groups in age, income, and education levels: the Puerto Rican sample included a higher percentage of individuals with an average family income below $10,000 than the other groups and about 43 percent of the Puerto Ricans examined were below the poverty line (computed by dividing the total household income by the total income determined necessary [from federal guidelines] to maintain a family on a nutritionally adequate diet; a ratio of 1.0 was considered as the poverty line) compared with about 29 and 22 percent of the Mexican and Cuban Americans, respectively.

All analyses were carried out using OSIRIS. IV, supported by the Institute for Survey Research, University of Michigan.

Results

Total Tooth Loss

Cuban Americans had a significantly higher prevalence of total tooth loss than both Mexican Americans and Puerto Ricans (Table 1). When the confounding effects of age, sex, income, and education status were accounted for using a logistic regression model, however, no significant differences in the prevalence of total loss among the three groups were found (data available on request to authors).

TABLE 1—Number of Mexican Americans, Cuban Americans, and Puerto Ricans, Ages Five through 74 Years, by Edentulous Status and Age, HHANES, 1982–84

	Mexican Americans		Cuban Americans		Puerto Ricans	
Age (years)	N*	%E**	N	%E	N	%E
5–17	2,528	.00	294	0.00	939	.00
18–44	2,252	.30	390	1.30	799	1.40
45–74	1,203	14.40	508	14.90	528	12.90
All Ages	5,983	2.60	1,192	6.10	2,266	2.80

*N = Total Number of Hispanics ages 5 through 74 years.

**%E = Percent edentulous (with total tooth loss) and, henceforth, were not included in Tables describing the status of individuals with teeth.

Dental Caries Prevalence

Among dentate Hispanics, ages five through 44 years, Puerto Ricans had a significantly higher mean number of decayed teeth than Cuban Americans (Table 2), but not Mexican Americans; this difference disappeared, however, when age, sex, income, and education status were accounted for using a multiple linear regression model (data available on request to authors). In older Hispanics, Mexican Americans had a significantly higher mean number of decayed teeth than either Cuban Americans or Puerto Ricans but, again the difference disappeared after accounting for the confounding effects of age, sex, income, and education status, using a multiple linear regression model (Table 3). Hispanic adults had significantly higher mean number of decayed teeth than Hispanic children.

Puerto Rican children had an average of 2.09 filled teeth compared with an average of 1.39 and 1.43 filled teeth for Mexican American and Cuban American children, respectively, a difference which remained statistically significant in the regression analysis (data available on request to authors). In adults, Puerto Ricans and Cuban Americans had at least 40 percent higher mean number of filled teeth than Mexican Americans (Table 2). In Hispanics older than 45 years, the mean number of filled teeth of Cuban Americans and Puerto Ricans was significantly higher in the regression analysis than that of Mexican Americans, with Cuban Americans having the highest mean number of filled teeth of the three groups.

Cuban American and Puerto Rican adults had approximately two times more missing teeth than Mexican Americans (Table 2). This difference did not disappear after accounting for the previously described confounding variables. Mexican American adults (18–74 years of age) who were

TABLE 2—Mean Number of Decayed, Missing, and Filled Permanent Teeth (and 95 Percent Confidence Intervals) of the Means of Dentate Mexican Americans, Cuban Americans, and Puerto Ricans by Age, HHANES, 1982–84

Age in Years	Decayed	Missing	Filled
Mexican Americans			
5–17	.70	.04	1.39
	(0.64, 0.76)	(0.03, 0.05)	(1.21, 1.57)
18–44	1.45	1.52	4.56
	(1.31, 1.59)	(1.39, 1.65)	(4.18, 4.94)
45–74	1.49	5.24	3.97
	(1.26, 1.71)	(4.85, 5.63)	(3.45, 4.49)
Total	1.19	1.56	3.36
	(1.11, 1.27)	(1.46, 1.66)	(3.15, 3.57)
Cuban Americans			
5–17	.51	.13	1.43
	(0.35, 0.66)	(0.07, 0.19)	(1.13, 1.73)
18–44	1.02	3.93	7.70
	(0.80, 1.24)	(3.46, 4.39)	(7.15, 8.24)
45–74	0.85	9.19	6.50
	(0.70, 1.00)	(8.59, 9.78)	(6.00, 6.99)
Total	0.85	4.87	5.88
	(0.74, 0.96)	(4.52, 5.21)	(5.56, 6.20)
Puerto Ricans			
5–17	.76	.11	2.09
	(0.67, 0.88)	(0.06, 0.16)	(1.80, 2.38)
18–44	1.40	3.58	7.43
	(1.27, 1.53)	(3.09, 4.07)	(6.89, 7.96)
45–74	.97	10.43	5.53
	(0.78, 1.16)	(9.25, 11.42)	(5.00, 6.06)
Total	1.10	3.26	5.15
	(1.00, 1.20)	(2.90, 3.62)	(4.83, 5.47)

TABLE 3—Multiple Linear Regression Coefficients of the Relation between Number of Decayed Teeth and Hispanic Identifier, Sex, Income, and Education: Age Group 45 to 74 Years of Age, HHANES 1982–84

Variables	Regression Coefficient	Standard Error*
Constant	2.66	.42
Hispanic Group		
Mexican American	.37	.23
Cuban American	−.04	.32
Sex (males, females)	−.48	.14
Income (Less than $10,000, $10,000–<$20,000, $20,000+)	−.16	.09
Education (Never, primary, high school, college)	−.31	.10

*Standard errors were adjusted for clustering effects (see Methods section). Confidence intervals were computed with adjustment for design effects as described in the Delgado, *et al.*, paper.[10]

below the poverty line had a significantly higher mean number of decayed teeth and a lower mean number of filled teeth than those above the poverty line. Differences in the mean numbers of decayed and filled teeth, by age groups, between Puerto Ricans and Cuban Americans below and above the poverty line were inconsistent because of small sample sizes.

Table 4 presents the distribution of dental caries by the type of tooth surface affected in Hispanic children. Puerto Ricans ages five to 17 years had significantly higher DFS (decayed and filled tooth surfaces) scores on occlusal surfaces than Mexican and Cuban Americans. In the buccal and lingual tooth surfaces of posterior teeth, Cuban American children had a significantly lower mean DFS than did Mexican Americans and Puerto Ricans. No significant differences were found among the children of the three Hispanic groups in the DFS of mesial and distal tooth surfaces of posterior or anterior teeth. Puerto Rican children had 58 percent of the carious activity occurring on occlusal surfaces, and the Cuban American and Mexican American children had 56 and 53 percent, respectively. If the buccal and lingual tooth surfaces are included, then the percent age of pits-and-fissures of posterior tooth surfaces affected by dental caries will increase to about 79, 85, and 85 percent of the total DFS scores in Cuban Americans, Puerto Ricans, and Mexican Americans, respectively.

Periodontal Disease

Puerto Ricans, ages five through 44 years of age, had a significantly higher prevalence of gingivitis than Cuban Americans and Mexican Americans (Table 5). In the oldest age group, Puerto Ricans and Mexican Americans had a significantly higher prevalence of periodontal pockets than Cuban Americans. Puerto Ricans, 18 to 74 years of age, also had significantly higher mean DI scores than Cuban Americans (Table 6). In a regression model controlling for the confounding effects of age, sex, diabetes (presence or absence of diagnosed diabetes), and oral hygiene status, Puerto Ricans remained with the highest prevalence of periodontal disease relative to the other two Hispanic groups. Diabetes status was included because it has been shown in a longitudinal study that diabetics had more gingivitis and periodontal pocketing than non-diabetics.[14]

Discussion

Untreated dental caries in Hispanic children and adults and the relatively high mean number of missing teeth in Cuban American and Puerto Rican adults compared with Mexican Americans and other Americans[3] are the two most important oral health problems facing Hispanics. It is important to note that Hispanic adults had twice higher mean number of decayed teeth than Hispanic children. This finding suggests that there is a strong cohort effect in the Hispanic population with different age groups experiencing different exposure to preventive and dental services. The presence of decayed teeth, however, does not mean that treatment of all carious lesions is urgently needed. Unfortunately, the criteria used during HHANES to measure caries[15] do not provide information about the severity of the carious lesions and therefore a decision on what mix of preventive and treatment services will be needed cannot be made. Also, the NIDR Restorative Treatment Need Index,[15] used during HHANES, does not provide information about the need for fissure sealants and whether small carious lesions should be restored or followed with recommendation for fluoride application to arrest the progress of the lesion. Given the concentration of carious activity in the pits and fissures of posterior teeth in Hispanic children, however, the effectiveness of fissure sealants in preventing dental caries on those surfaces will be higher than other preventive methods.

In a previous analysis of National Health Interview Survey (NHIS) data collected during 1978–80, Mexican Americans, Cuban Americans, and Puerto Ricans visited the dentist less frequently than White non-Hispanics.[16] Mexican Americans had the lowest proportion of persons who went to a dentist within a year compared with Puerto Ricans and Cuban Americans. Mexican American use of dental services resembled the pattern of dental care received by Black

TABLE 4—Mean Number of Decayed and Filled Tooth Surfaces (DFS) by Type of Tooth Surface Affected in Dentate Mexican Americans, Cuban Americans, and Puerto-Rican Children, 5–17 Years of Age, HHANES, 1982–84

	Posterior Teeth			Anterior Teeth	
	Occlusal	BL	MD	BL	MD
Mexican Americans	1.79 (1.64, 1.94)	1.06 (0.97, 1.15)	.30 (0.24, 0.36)	.10 (0.07, 0.13)	.10 (0.06, 0.14)
Cuban Americans	1.67 (1.38, 1.96)	.66 (0.51, 0.81)	.38 (0.23, 0.53)	.09 (0.03, 0.15)	.14 (0.04, 0.24)
Puerto Ricans	2.56 (2.28, 2.83)	1.29 (1.12, 1.46)	.36 (0.25, 0.47)	.06 (0.03, 0.09)	.10 (0.05, 0.15)

Occ = Occlusal
BL = Buccal, Lingual
MD = Mesial, Distal

TABLE 5—Percent Distribution of Dentate Mexican Americans, Cuban Americans, and Puerto Ricans by Periodontal Disease Status* and Age, HHANES, 1982–84

	Gingivitis Only			Periodontitis		
Age (years)	Mexican American (95% CI)	Cuban American (95% CI)	Puerto Rican (95% CI)	Mexican American (95% CI)	Cuban American (95% CI)	Puerto Rican (95% CI)
5–17	76.6	65.1	90.0	.2	.0	.1
	(73.4, 79.8)	(59.4, 70.8)	(87.3, 92.7)	(−.14, .54)	—	(−.2, .4)
18–44	82.4	81.2	90.0	7.0	2.1	8.2
	(79.3, 85.5)	(77.1, 85.3)	(87.1, 92.9)	(4.9, 9.1)	(.6, 3.6)	(5.5, 10.9)
45–74	59.1	72.3	65.1	35.7	20.8	32.4
	(53.2, 65.0)	(67.9, 76.7)	(58.9, 71.3)	(29.9, 41.5)	(16.8, 24.8)	(26.3, 38.5)

*Periodontal Disease Status is based on Periodontal Index Scores.[12] Those with no periodontal disease are not included and therefore the percentages do not add up to 100.

TABLE 6—Mean Number of Debris Index (DI) and Calculus Index (CI) Scores[13] (and 95 Percent Confidence Intervals) of the Means for Dentate Mexican Americans, Cuban Americans, and Puerto Ricans, Ages Five through 74 Years, HHANES, 1982–84

Age (years)	Mexican American	Cuban American	Puerto Rican
Debris Index scores			
5–17	.80	.72	.78
	(0.76, 0.84)	(0.66, 0.78)	(0.74, 0.82)
18–44	.75	.62	.86
	(0.70, 0.80)	(0.57, 0.67)	(0.81, 0.91)
45–74	.94	.72	1.04
	(0.84, 1.04)	(0.65, 0.79)	(0.95, 1.13)
Calculus Index scores			
5–17	.09	.04	.16
	(0.08, 0.10)	(0.02, 0.06)	(0.13, 0.19)
18–44	.67	.43	.77
	(0.63, 0.71)	(0.37, 0.49)	(0.70, 0.84)
45–74	1.30	.75	1.23
	(1.22, 1.38)	(0.68, 0.82)	(1.11, 1.35)

Americans. Puerto Ricans were the only group for whom dental visits were not significantly influenced by family income level. In this study, the dental caries prevalence of Mexican Americans parallels that found in Black Americans during the 1985–86 NIDR survey.[3] (Comparisons between HHANES findings and other national surveys are limited by the differences in sampling strategies. Examination criteria used during HHANES, however, were those used by NIDR, and the training of the dental examiners in HHANES was also carried out by NIDR staff.) Puerto Ricans and Cuban Americans had a dental caries distribution that was in between those of Mexican Americans and Blacks, and White Americans in the NIDR survey. The influence of dental visit patterns, income, and dental education may partly explain the differences in the mean number of missing teeth among the three Hispanic groups.

The results of the analysis of HHANES dental data reported here raise a number of methodological questions about the meaning of the DMF score. Conventionally, the DMF score has always been analyzed as a single composite index. Moreover, analysis of the DMF score of an individual assumed that all filled teeth have been treated because they were previously carious. The filled component of the DMF index represents a decision made previously by the dentist of the examinee. As has been documented by several investigators[17,18] the diagnostic criteria used by dentists to decide on need for restorative treatment are plagued with considerable variations. In a study in Scotland, where 15 general practitioners examined 18 patients and estimated their restorative treatment needs, the range of teeth needing treatment for each patient varied according to the examining dentist.[17] For the 18 patients together, the costs of the treatment planned by the 15 dentists ranged between 92.5 and 478.6 British pounds. These findings raise doubts about the validity of analytic methods for the DMF index that combine the three components of the index as a single variable.

As in Mexican Americans, the prevalence of gingival inflammation and periodontitis in Puerto Ricans and Cuban Americans is higher than national averages.[3] Puerto Ricans had the highest prevalence of gingivitis. Puerto Ricans and Mexican Americans also had a higher prevalence of calculus and debris than Cuban Americans. The level of DI and CI scores in Mexican Americans and Puerto Ricans, 18–74 years of age, is higher than that determined to be compatible with an acceptably low level of periodontal disease.[19]

In conclusion, the oral health status of Hispanic-Americans can be summarized as follows:

- Total tooth loss is not a public health problem in Hispanic Americans examined during HHANES. However, the dentate Cuban American and Puerto Rican adults have about twice as many missing teeth than White non-Hispanics.
- In children, while the prevalence of dental caries is low, using the World Health Organization criteria,[20] the tooth surfaces most affected by dental caries are the pits and fissures of posterior teeth rather than smooth tooth surfaces. These findings support the need for sealant programs to prevent dental caries.
- Hispanic adults had twice higher mean number of decayed teeth than Hispanic children. Puerto Ricans and Cuban Americans had a higher mean number of filled and missing teeth than Mexican Americans. The distribution of dental caries in Mexican Americans was similar to that found in Blacks in 1985–86.[3] Puerto Ricans and Cuban Americans had a dental caries distribution between that of Black and White Americans.[3]
- The prevalence of gingivitis in Hispanics is higher than that found in White non-Hispanics.[3] Puerto Rican children and adults had the highest prevalence of gingivitis among the Hispanic groups.

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Public Health Policy Forum

Disease Control Priorities in Developing Countries: Health Policy Responses to Epidemiological Change

Dean T. Jamison, PhD, and W. Henry Mosley, MD, MPH

ABSTRACT

Health systems in developing countries are facing major challenges in the 1990s and beyond because of a growing epidemiological diversity as a consequence of rapid economic development and declining fertility. The infectious and parasitic diseases of childhood must remain a priority at the same time the chronic diseases among adults are emerging as a serious problem. Health policymakers must engage in undertaking an epidemiological and economic analysis of the major disease problems, evaluating the cost-effectiveness of alternative intervention strategies; designing health care delivery systems; and, choosing what governments can do through persuasion, taxation, regulation, and provision of services. The World Bank has commissioned studies of over two dozen diseases in developing countries which have confirmed the priority of child survival interventions and revealed that interventions for many neglected and emerging adult health problems have comparable cost-effectiveness. Most developing countries lack information about most major diseases among adults, reflecting lack of national capacities in epidemiological and economic analyses, health technology assessment, and environmental monitoring and control. There is a critical need for national and international investment in capacity building and essential national health research to build the base for health policies. (*Am J Public Health* 1991;81:15–22)

Introduction

The policy debate in international health has often been polarized around conflicting viewpoints on such issues as preventive versus curative services, selective versus comprehensive primary health care, or integrated versus vertical programs. As we approach the 21st century, it is becoming clear that framing the issues in these terms will not enlighten the policy process, primarily because it limits the options largely to actions that can be carried out directly by ministries of health. Profound social and economic transformations are projected to impact on health in the developing countries in the 1990s and beyond; implications for the epidemiological profiles of these countries will be dramatic.[2–4] A more comprehensive analytical approach is required to formulate health policies that will not only respond to but actually guide the development process to maximize its health gains, minimize its potential adverse consequences, and deal cost-effectively with the emerging quantitative importance of noncommunicable diseases.

Over the next decade there will indeed remain perhaps 30 to 40 countries in the lowest income bracket where the health problems will be dominated by the infectious and parasitic diseases of childhood along with undernutrition and high fertility.[5] Most of these are in Sub-Saharan Africa and South Asia, and intervention strategies must continue to focus on establishing basic infrastructures and delivering established, low-cost technologies.[6] At the same time, however, there will be a larger group of countries, predominantly in Latin America and East Asia, that are newly emerging into the middle income category. Most of these countries are not free of the infectious diseases, yet at the same time are beginning to face a new set of health problems related to rapid urbanization and industrialization.[3,7,8] These include: injuries, occupational diseases and, increasingly, preventable chronic diseases among an aging population.[9] Such a growing epidemiological diversity among and within countries in the developing world demands a flexible approach to international health policy formulation.

Policy Development

It is useful to consider health policy development as involving three complementary tasks: first, *identifying the major disease problems*, assessing their social and economic consequences, and evaluating the costs and effectiveness of alternative intervention strategies; second, *designing health care delivery systems* including establishing the human and physical infrastructures, providing for drugs and logistical support, and developing managerial capacities and funding mechanisms; and third, *defining and choosing what governments can do* through the full range of policy instruments that are at their disposal in the areas

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This paper, invited by the editor, draws in part on a forthcoming book edited by Jamison and Mosley[1]; it is based on work undertaken and supported by the Population, Health, and Nutrition Division of the World Bank. The views expressed in this paper are those of the authors and do not necessarily represent those of the World Bank. The authors are indebted to Drs. D. A. Henderson and A. R. Measham for valuable comments.

of persuasion, taxation, regulation and the provision of services.

Like a three-legged stool, coherent health policies require a solid foundation of technical analysis in all three areas in order to identify effective strategies and establish sustainable programs. Through the 1960s and 1970s the second task, designing institution-based delivery systems, (generally following a Western medical model) was the dominant theme in health policy formulation for the developing world. It was in this period that the policy debates centered around the relative allocation of resources for preventive versus curative services and, when disease eradication programs were being implemented, vertical versus integrated programs. The Alma Ata Conference on Primary Health Care in 1978 introduced the principle of "Health For All."[10] Conceptually this encompassed all health problems in the population, was community-based, and involved all sectors of government. Given the resource constraints in the health sector, many health professionals and donors narrowed the agenda, limiting consideration to childhood communicable diseases.[11] This led to selective primary health care programs focusing largely on population-based technical interventions such as oral rehydration therapy and immunizations for child survival[12] which, in turn, led to policy debates about the relative merits of selective versus comprehensive primary health care interventions.[13]

The third task, assessing the full array of government instruments available, particularly those outside the traditional purview of ministries of health (such as regulation and taxation) to protect and promote the health of populations is not well established in much of the developing world. The full range of instruments is, however, fully entering the public debate on policy in a number of industrialized countries. For example, in the United States the process was initiated with the publication of "Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention" in 1979 which defined a set of health goals for 1990 for infants, children, adolescents, adults, and the aged.[14] To achieve these goals, 15 priority areas for intervention were identified and grouped under three strategic approaches: preventive health services, health protection, and health promotion.[15] Preventive health services included: primary preventive interventions such as immunizations and family planning, secondary prevention for conditions like high blood pressure as well as curative services for such conditions as sexually transmitted diseases. Health protection encompassed areas where regulation and taxation would be important including toxic agent control, occupational safety, accident prevention, and fluoridation. The health promotion strategies—involving behavioral changes related to smoking, alcohol and drug abuse, diet and exercise—required government interventions not only in education but also through regulation and taxation.

The process of setting national objectives in the US has now been extended with *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.*[16] Based on three years consultation with more than 300 national organizations and state health departments, the goals have been reformulated to go beyond mortality reduction: to increase the span of healthy, disability-free life; to reduce disparities in health by giving more attention to the vulnerable high risk groups such as the poor, minorities, and the elderly; and, to increase access to basic health services.[16] In this context, new priority areas have been added such as cancer screening, AIDS, preventive health services, and surveillance.

Three factors have been key to the successful mobilization of public and professional interest and debate in the United States.[17] First, there was a clear definition of the health problems of concern and their social and economic as well as medical determinants. Second, the 15 priority areas selected for health improvement were further subdivided into 227 health promotion objectives for the 1980s.[18] These detailed objectives represented precise, quantifiable management strategies which were realistic in terms of resource constraints and time frame for implementation, yet demanding enough to push the system to new levels of capability. Third, the *process* of problem identification and health policy formulation involved the broadest participation of all segments of society.[19] On the one hand, a considerable breadth of expertise was drawn from the fields of epidemiology, management sciences, economics, behavioral sciences, and communications to define the problems and issues to be addressed and propose strategic alternatives. On the other hand, there was broad political and public participation in devising solutions. The necessity of this third step (which is rare in developing countries) cannot be overemphasized: the policy formulation process should be an educational experience about the health problems for all concerned since it will be necessary to reach a wide national consensus on issues, policies and implementation strategies which will cut across many sectors including finance, trade, agriculture, transportation, industry, education, and others. It must also be emphasized that successful mobilization of debate and concern is far from sufficient, as the example of the US also, unfortunately, attests. Where the political will for public action is lacking and resources are unallocated, health outcome indicators, such as infant mortality rates among minority groups, can remain shamefully high.

A first task in a comprehensive analysis of the health sector requires an estimation of the burden of disease in the population. This should be done in a framework that considers not only the capacity of the health system to deal with these diseases but also the rapidly changing social, economic, and political context that may be influencing both the structure and organization of the health system as well as disease risks and health behaviors in the population. Because of the extraordinary diversity among developing countries, it is unrealistic and, indeed, inappropriate to come up with global policies; rather, what is presented here is a conceptual and analytical approach with illustrations of the range of factors which must be considered in any particular setting. This approach takes into account that there will be a continuing evolution of disease control priorities based on the social and economic transformations countries are undergoing with their accompanying demographic and epidemiologic transitions.[20]

The Changing Determinants of Disease

A first determinant of the changing health picture developing countries will be experiencing is the demographic transition, largely driven by the rate of fertility decline. This will produce major changes in the age structure of populations which will have a large impact on the health picture.[21] Table 1 taken from World Bank projections for the period 1985 to 2015 illustrates the changing demographic and health picture for developing countries worldwide.[22] Overall, slower growth of the childhood population coupled with declining death rates are projected to reduce the health problems of all age groups. But this is more than counterbalanced by the

TABLE 1—Health Problems of Different Age Groups

Age Group	Population in Developing Countries, millions		Deaths in Developing Countries, millions		Important Health Problems	
	1985	2015	1985	2015	Problems on the Unfinished Agenda	Neglected and Emerging Problems
Young children (0–4 years)	490	626	14.6	7.5	Diarrheal disease ARI Measles, tetanus, polio Micronutrient deficiencies Malaria	Injury
School-age Children (5–14 years)	885	1196	1.6	1.3	Schistosomiasis Geohelminth infection	Adolescent pregnancy Disability
Young adults (15–44 years)	1667	2918	5.0	6.0	Maternal mortality Malaria Excess fertility	Tuberculosis Injury AIDS STDs Mental Illness
Middle-aged (45–64 years)	474	1131	5.9	10.4		Cardiovascular disease Cancers COPD
Elderly (65+ years)	153	358	11.0	22.5		Disability Depression
TOTALS	3669	6229	37.9	47.7		

SOURCE: Jamison and Mosley, (forthcoming)[1]

NOTE: Many of the conditions for older age groups manifest themselves clinically long after the processes leading to the clinical condition have been initiated; preventive intervention will therefore need to be directed to younger ages.

AIDS: acquired immunodeficiency syndrome
STDs: sexually transmitted diseases
COPD: chronic obstructive pulmonary disease
ARI: acute respiratory infection

rapid increase in the adult and aging population. Regionally the picture is much more diverse. The population of children under age five in Latin America and Asia will increase by only 2 percent to 5 percent, respectively, in size. By contrast, this age group is projected to grow 38 percent in the Middle East and 70 percent in Sub-Saharan Africa from 1985 to 2015. Clearly the future requirements for maternal and child health services will be quite different across these regions. At the other end of the age spectrum a very different picture emerges. In all of these regions the populations over age 65 will be dramatically growing in size with projected increases ranging from 134 percent to 164 percent. This continuing growth in the older age groups is due to a phenomenon called the "momentum" of population growth; it is a consequence of the large numbers of children born in the past when fertility was high who advance through older age groups over time. The result is that essentially all developing countries will have to provide for the health needs of a rapidly increasing adult and aged population for many years into the future.[4] A broad assessment of how to meet these needs may be found in Feachem, *et al*, (forthcoming).[23] At the same time, in those countries where the fertility transition is barely underway (largely in Sub-Saharan Africa), policymakers must simultaneously plan to continue to rapidly expand maternal and child health services.

A second determinant of the changing health picture is the major social and economic trends which are transforming the risk factors themselves.[24] The most obvious indicator of these trends is the shift from rural to urban living. In 1985, barely over 30 percent of the population of the less developed regions lived in urban areas, but this pattern is changing rapidly.[25] The urban population will reach 40 percent by the year 2000 and surpass 50 percent by the year 2015. Already seven of the world's 12 megacities (population 10-million or more) are in developing countries. By the year 2000 the developing world will add six more cities to this number.

A shift from a rural subsistence economy to an urban market-oriented industrial economy is generally associated with reductions in risks to communicable diseases because of better sanitation in urban areas. At the same time, however, economic growth brings with it new health problems.[26] Very high rates of injuries related to motor vehicles, industrial accidents, and toxic chemicals (e.g., pesticides) are usually seen in developing countries because of a lack of resources and institutions to establish and enforce safety measures.[27] Undernutrition may diminish because of improved markets, only to be replaced by overnutrition with rising risks of death due to obesity, hypertension, atherosclerosis, and diabetes.[28] Rising incomes also bring changes in lifestyle including increases in smoking, alcohol use, and substance abuse, all of which are expected to increase the risk for chronic diseases.

An analysis of the tobacco-related diseases provides an excellent illustration of how a disease-oriented approach can inform health policy.[29] In the United States it is now well established that tobacco use is responsible for more than 30 percent of all cancer deaths as well as being among the strongest risk factors for chronic obstructive pulmonary disease and ischemic heart disease.[30,31] In recent years, rising rates of lung cancer associated with cigarette consumption have been observed in Japan, Singapore, and Shanghai.[32] A recent analysis by the World Bank has documented a direct relationship between tobacco consumption and higher levels of national income among developing countries.[33] This relationship is not coincidental. Rather, it is driven by promotion, pricing, tax policies, and even international trade relations. The impact of the latter is best attested by the rapid increases in cigarette consumption among young people in several east Asian countries where multinational tobacco corporations have recently opened new markets, assisted in some cases by aggressive (even coercive) trade policies of the United States Government.[34]

Taking China as an example, Peto projects that if current smoking trends continue due to a failure to introduce the array of policies necessary to reduce tobacco consumption in the next several years, an estimated two million Chinese men will die annually from tobacco-related health problems by the year 2025.[35] Cumulatively, one may anticipate 50 million tobacco-related deaths among the 500 million Chinese now under the age of 20. National policies to protect populations from tobacco-related diseases clearly must move beyond the usual realm of the health sector into areas of regulation and taxation of the industrial enterprise related to the manufacture and distribution of tobacco products and, in many countries including the United States, ultimately into a restructuring of rural economies where tobacco is produced.[36-38]

The AIDS (acquired immunodeficiency syndrome) epidemic provides another illustration of some of the links between economic development and disease transmission. In assessing the situation in Sub-Saharan Africa, Over and Piot document a strong correlation between the rate of HIV infection in 18 cities, a high ratio of males to females in urban centers and a low level of female education.[39] The implications of these findings are that AIDS transmission is facilitated by development strategies which favor males for urban employment. This generates a high demand for prostitutes; prostitution, in turn, is facilitated by low levels of female education so that women have few alternative economic opportunities open to them. An AIDS-control program must go beyond promoting the use of condoms and treating sexually transmitted diseases (STDs) and consider broader social policies relating to female education and labor force participation.

Epidemiologic Polarization

The epidemiologic transition in the developing world is neither a steady nor a uniform process. The great variations in life expectancy between countries attests to this; as of 1988, a dozen Sub-Saharan African countries still had life expectancies under 50 years, while an equal number of countries in Latin America and Asia (including China) had life expectancies of 70 years or greater.[40] Additionally, within developing countries (and developed countries as well) wide disparities in health conditions across different social classes or different regions are not uncommon. Frenk and colleagues have referred to these disparities as "epidemiologic polarization" and "epidemiological stagnation."[3,41] These disparities are not limited to the infectious diseases of infants and children but include the chronic diseases of adults as well.[7,23] A centrally important conclusion for health policy is that in most developing countries pre- and post-epidemiological transition problems will coexist.[41] As Foege and Henderson have observed, the developing countries ". . .will not have the luxury of dealing with two kinds of problems sequentially. For the remainder of this century they will be dealing with both simultaneously."[42]

The increasing burden of chronic disease is initially likely to affect the relatively more affluent and politically vocal older groups who are growing in numbers. This being the case, governments will need to take great care to assure that the infectious diseases which predominantly affect children and the poor are not neglected in the face of resource demands placed in large measure by the more affluent. The challenge is to develop equitable policies and strategies to meet these unprecedented conditions in the developing world.

Assessing Disease Control Priorities

The World Bank, as a part of an exercise to assess the cost and effectiveness of alternative intervention strategies for over two dozen acute and chronic diseases of adults and children, commissioned a series of analytical studies, each co-authored by individuals combining economic, epidemiological, and clinical expertise. Cost effectiveness was expressed in terms of dollar cost per discounted healthy life years gained (DHLY). The details of these studies are reported elsewhere.[43] Several general conclusions which emerged from this undertaking will be described here in terms of their implications for the process of policy development in developing countries.

First, while child survival interventions (immunizations, provision of antenatal and delivery care, vitamin A supplementation, improvements in domestic hygiene, oral rehydration therapy [ORT] for diarrheal diseases in high mortality environments, and antibiotic therapy for acute respiratory infections) appear to be highly cost-effective ($5-50 per DHLY), there were a range of adult health interventions which were estimated to be equally cost-effective. Among the most prominent are: anti-smoking campaigns plus tobacco taxes, passive case finding and short-course chemotherapy for tuberculosis, the targeted management of sexually transmitted diseases, cataract surgery, the use of condoms to prevent HIV transmission, and hepatitis B immunization to prevent liver cancer and cirrhosis. At the other extreme, the cost per DHLY for a number of adult diseases is so high (greater than $1000) that public policy should probably discourage their use in settings where health resources are severely constrained. Among these are coronary bypass surgery, mitral valve replacement for rheumatic heart disease, medical management for hypertension, and tertiary management of lung, liver, esophageal, and stomach cancer. With reference to cancer, it should be noted that cancer pain control appears to be a relatively cost-effective intervention for adults ($150 per DHLY) reaching the same level as: maternity care services for maternal mortality; public preventive campaigns to prevent cardiovascular disease; medical management of angina; and insulin management of insulin-dependent diabetes melitis.

This analytical approach revealed a number of neglected and emerging health problems which should be accorded far higher priority. Topping the list of emerging problems are the tobacco-related diseases which, interestingly enough, were not even mentioned in the 1980 World Bank Health Sector Report.[44] Tuberculosis appears to be the greatest "neglected" disease.[45] In 1990 there will be an estimated 8.4 million new cases and 2.7 million deaths, over two-thirds of which will be among productive adults (ages 15–59), primarily the poor. Significantly, this disease alone accounts for about 37 percent of an estimated seven million avoidable adult deaths in the developing world.

Some findings challenge the current international donor commitment to global priority setting. Provision of ORT *in low mortality environments* (at $200 per DHLY) is estimated to be about 20 times less cost effective than tuberculosis control (using passive case detection and short course chemotheraphy) or leprosy rehabilitation. Even cervical cancer screening (Papanicolaou smears) are estimated to be an equally good buy for the money. In *high mortality environments,* in contrast, ORT can be quite cost-effective, underscoring the need for analysis at the country or even district level.

A major observation from the World Bank exercise is the paucity of empirical data from a majority of the developing countries about most of the major chronic diseases of adults.[23,46] Considering that, on a global level, more than half the world's deaths due to cancers and cardiovascular diseases, three-fourths of the injury deaths, and 85 percent of the chronic obstructive pulmonary disease deaths occur in developing countries, the virtual absence of any information about the levels, trends, and determinants of these conditions for the majority of the world's population is truly tragic. Given this lack of developing country data, most of the estimates of the cost-effectiveness of interventions for the World Bank study had to be derived from research carried out in the industrialized world. While these estimates are probably reasonable in grossly illustrating the relative cost-effectiveness of alternative interventions, the actual cost-effectiveness of a particular intervention could easily vary by two- to tenfold or more in any given situation, depending on a host of local factors. For example, with interventions, like immunizations, that require total population coverage, cost-effectiveness is strongly conditioned by the underlying level of disease incidence and case fatality rates. For therapeutic interventions, cost-effectiveness is determined not only by the institutional costs of reaching the target group and then making the correct diagnosis, but also by the probability that appropriate therapy will be prescribed by the caregiver and that the patient will actually comply with the treatment regimen.[47-50] Similarly, the costs of monitoring and enforcing regulatory approaches depend upon the reach and capability of the governmental infrastructure.

Implications for National Governments

It should be clear that there is an urgent need to reassess health sector priorities in developing countries. National health policy assessment can be usefully informed with a consideration of global trends and findings such as presented above, but it must quickly evolve to a critical analysis of the local epidemiological picture cast in its social-cultural, administrative, economic, and political context. Such an approach to policy formulation must begin by assessing the full range of health problems in a society; examining broadly their demographic, social, and economic determinants; and identifying alternative courses of action in all of these areas which could improve the situation. This last step must take into consideration the costs and effectiveness of all possible instruments of government intervention including taxation and regulation as well as persuasion and the direct provision of services.[4]

Many governments will need to create new institutions and reconfigure old ones to build the capacities required for policy analysis and implementation. Among the analytical and technical capacities required are the following:

- *Demographic analysis*—These capabilities provide the fundamental underpinnings for a population-based health system. Demographic data provide the basis for designing intervention strategies as well as for assessing the impact of the disease burden on the population.
- *Epidemiological surveillance*—While some epidemiological surveillance is carried out in most developing countries, it is usually limited to selected infectious diseases. These capacities will need to be greatly strengthened as health program strategies move more toward interventions involving regulation, taxation, subsidies, and information programs in order to reduce acute and chronic disease risks by changing behaviors and improving environmental conditions.
- *Economic and financial analysis*—These capabilities will be essential to measure the cost-effectiveness of alternative intervention strategies as well as to assess the overall claim of the health sector on scarce development resources.
- *Health technology assessment and control*—Institutional capabilities in this area must include not only the assessment of the effectiveness of new drugs, vaccines or treatments, but also their costs and benefits when introduced into the health system.
- *Environmental monitoring and control*—In most developing countries capabilities in this area must be greatly expanded beyond the traditional water and sanitation activities to monitor and control (through taxation as well as regulation) a much broader range of environmental risks including air pollution, toxic wastes, traffic hazards, and other injury risks.
- *Occupational safety*—Rapid urbanization and industrialization in developing countries is often associated with risks of work-related injury five to 10 times higher than in developed countries. There is a major need to develop the capacity to monitor and control occupational health risks.

While many of these institutional capacities exist in some measure in health ministries, their functions are limited for a variety of reasons including lack of professionally qualified personnel, limited resources and, particularly, lack of enforceable statutory authority. If health systems are to be transformed to meet the challenges of the future, a high priority must be given to empowering health ministries to carry out the monitoring and regulatory tasks needed to effectively function in new areas. In addition, mechanisms need to be established that will give them an appropriate voice in tax policy. Ultimately these capacities will need to be developed at regional and local levels within countries as well as at the national level.

Implications for International Aid

Official development financing for health by bilateral and multilateral donors in 1986 amounted to $3.7 billion with the US contribution accounting for 16 percent of the total.[51] While external support represents only a small fraction of the total public and private sector health expenditures in developing countries, in fact, because much of the donor assistance is directed toward the poorest countries, its proportional impact in influencing health policies and program strategies is relatively large. This is particularly true when it promotes policies which lead to a reallocation of national resources. The impact of the donor-driven child survival initiative in promoting immunizations and oral rehydration therapy worldwide is an excellent illustration of this.[52]

TABLE 2—Instruments of Aid

Objectives	Modality of Assistance	
	Program Implementation	Capacity Strengthening
1. Service Delivery	Supports acquisition of drugs, equipment, and technical assistance, for delivery of EPI, vector control programs, hospital services, etc.	Invests in institutional development and staff training to improve efficacy of service delivery—e.g. through improved logistics and supply systems.
2. Policy Improvement	Identifies specific areas of policy improvement (e.g. tobacco advertising bans or introduction of cost-recovery mechanisms) and includes them (usually with conditionality) as part of an assistance package.	Invests in development of policy and planning departments in ministries or universities; invests in staff training and advanced education.
3. Undertaking Research (including epidemiologic, evaluational and economic analyses)	Conducts (perhaps with involvement of aid agency or expatriate staff) research or analyses to strengthen formulation of policy or delivery of service.	Invests in national (and international) capacity for undertaking research relevant to epidemiological and economic conditions of developing countries. This capacity strengthening involves both institutional and human resource development.

In looking to the future, it is useful to categorize international aid on the basis of whether its objective is to: 1) support the provision of services; 2) influence the policy environment; or 3) support research. Table 2 divides approaches to meeting these three objectives into two modalities of assistance: program implementation and capacity strengthening. Program implementation is largely oriented toward short-term results, while capacity strengthening generally requires long-term investments in institutional development. Traditionally, the dominant role of international assistance has been to provide services and related commodities where they were unavailable or inadequate; most donor support to child survival programs falls in this category. Recently, more attention is being given to structuring aid to change the policy environment, either directly, for example, by channeling more support to private and non-profit NGO (nongovernmental organizations) sectors, or indirectly by attaching conditions to aid packages, for example, by requiring cost recovery or extension of services to underserved populations. Presently only a small fraction of aid is directed toward research, much of which, in fact, is in specialized programs such as the Tropical Disease Research Program or in a few institutions like the International Center for Diarrheal Disease Research, Bangladesh.[53]

The earlier discussion has highlighted the fact that developing countries are now moving through the epidemiologic transition at very different paces and often incompletely. As a result there is a great diversity both in health conditions and in institutional capacities among and within countries.[2] This creates a far more diffuse planning environment than existed when most of these countries were still in a pre-transitional stage two or three decades earlier. No longer can a few strategic objectives command central importance for health policy. Rather, a much broader range of relatively less prominent health conditions and associated interventions will compete for resources and attention. In light of this, and given the fact that extremely little is known about the levels, trends, and determinants of the majority of diseases afflicting populations in the developing world, the conclusion is inescapable that as far as donor assistance is concerned, far higher priority should be given to research, both building research capacity and conducting research to strengthen the formulation of health policy. This, in fact, is the conclusion reached by the Commission on Health Research for Development in its recent report.[53] The Commission specifically placed a high priority on local epidemiological and operational analyses which they labeled as "Essential National Health Research" (ENHR).

Broadening the array of diseases for consideration to encompass all ages and expanding the arena of policy options to include the full range of instruments for government intervention will demand a diversity of analytical skills. National governments will require broad technical competence not only in the biomedical and clinical sciences including epidemiology but also in economics, sociology, anthropology, the management sciences, and communication. In most countries, new institutions may need to be developed. The international donor community generally, and the United States in particular, could most effectively use its limited resources in the areas of education, training, research, and technical assistance, where it has strong comparative advantage.[54] Furthermore, because most of the major disease problems are actually of global concern (e.g. tobacco-related diseases, substance abuse, AIDS, injuries, occupational diseases, cardiovascular disease, cancer, malnutrition) much could be gained through international collaborative endeavors in these disease control efforts.

Conclusion

For over a decade the international public health community has given a priority to the communicable childhood diseases. This had been appropriate. The problems are major, the technological and epidemiological tools have become powerful, and the payoff for adapting and applying what is known is high. While the implementation strategy for selective primary health care as originally proposed by Walsh and Warren may have been oversimplified and too narrowly concerned with infectious diseases, the problem-oriented, population-based conceptual approach is fundamentally correct.[11,55] Furthermore, as more and more governments have seriously addressed the problem of child survival, the range of interventions has broadened.[56] For example, diarrhea control programs have moved from simply relying on packets of oral rehydration salts to the use of homemade fluids, the dietary management of diarrhea, the promotion of personal hygiene, and use of soap. More importantly, policy recommendations supporting child survival have now expanded widely, encompassing such issues as female education and the status of women.

The rapid demographic transition that many developing countries are undergoing is now producing great epidemiological diversity among developing countries; this demands that health policymakers consider a broader range of options. Over the next 25 years it is not unreasonable to project a 50 percent to 60 percent decline in the numbers of deaths among infants and children related to advances in child health coupled with rapidly declining birth rates which will stabilize the numbers of newborns from year to year over much of the world. Overall, however, there will be a rise in the total number of deaths as the population evolves toward an older age structure. The epidemiological transition is not occurring uniformly, however, and most countries will have a large lingering burden of communicable diseases among children, particularly in Sub-Saharan Africa where the fertility transition has hardly begun. This situation will impose the greatest challenge on health systems operating under constrained resources to select the most effective and efficient means of disease prevention, case management, and rehabilitation.

It must be emphasized that extending the range of choices means not only choosing to implement new initiatives but also choosing to reduce investments of public funds in health care activities that are clearly not cost-effective. While this may be difficult, given the traditions of Western medical practice, the fundamental issues of equity as well as efficiency are involved. Efficient resource allocation is desirable in every sector. In the health sector, however, in a very direct way, unnecessary death, disability, and illness occurs if resources are committed to one intervention when another has higher health gains per unit of expenditure. The human cost of uneconomic resource allocation is very real and very large. Perhaps even more than in other sectors, then, the imperative exists for policymakers in the health sector to undertake constant assessment of intervention cost-effectiveness.

Probably the most important advance in policy formulation that could come from a disease-control strategic approach is a willingness to consider a range of options available to governments beyond the direct provision of health services. Particularly important as countries are moving through an accelerated process of economic development is the judicious use of regulation, legislation, taxation and subsidies to promote or discourage enterprises, activities, or behaviors which may have health consequences. Also, the importance of mass communication for social mobilization to promote health cannot be over-emphasized. A high priority problem demanding such multi-faceted policy intervention and global cooperation is tobacco consumption.

It is universally recognized that improved health in the broadest sense is a fundamental indicator of the development process. As the Nobel Laureate T. W. Schultz observed, ". . .the wealth of nations (has) come to be predominantly the acquired abilities of people—their education, experience, skills, and health."[57] The task of health policy is to define clear, realistic, and measurable objectives which can guide the development process toward effectively and efficiently producing good health for all. ☐

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Patterns of Medical Employment: A Survey of Imbalances in Urban Mexico

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ABSTRACT

This article quantifies the magnitude and correlates of the major imbalances affecting the employment of physicians in the urban areas of Mexico. Since the early 1970s the country has experienced a rapid increase in the supply of doctors, which its health system was unable to absorb fully. In 1986, we conducted a survey in the 16 most important cities based on a probability sample of households where someone with an MD degree lived. A total of 604 physicians were interviewed for a response rate of 97 percent.

The unemployment rate was 7 percent of potentially active physicians; 11 percent held a nonmedical job, and another 11 percent exhibited low productivity and/or income. All in all, we project that 23,500 physicians in these cities were either unemployed or underemployed.

This medical employment pattern was analyzed against five independent variables: generation (i.e. the year in which the physician started medical school), gender, social origin, medical school quality, and specialty. Apart from generation, type of specialty exhibited the strongest correlation with the employment situation of a physician.

The results suggest that higher education and health care in Mexico may be producing rather than correcting social inequalities. Policy alternatives are discussed to restore a balance between the training of physicians, their gainful employment, and the health needs of the population. (*Am J Public Health* 1991; 81:23–29)

Introduction

Among the many paradoxes of contemporary health systems probably none is so indicative of failure as the coexistence of underemployed physicians with underserved populations. This is the situation that today prevails in many countries of the world.[1] For reasons that are not yet fully understood, a wide variety of nations, with very different levels of economic development and political structures,[2] experienced during the last decades substantial increases in the supply of physicians, which the health system was often unable to absorb.[3] The result has been the appearance of manpower imbalances that have assumed manifold manifestations.[4]

In order to contribute to our understanding of the dynamics of medical employment, the present article analyzes the case of physicians in the urban areas of Mexico. Apart from the intrinsic interest of the subject, the Mexican health care system offers the analytical advantage of encompassing virtually all organizational forms of medical work, from independent practice to salaried jobs in the public sector; extreme forms of imbalances such as underemployment and unemployment exist The conceptual framework and specific methodology we have developed may be relevant to other nations.

Overview: The Medical Labor Market in Mexico

From the establishment of the first course of medicine in 1578 until the beginning of the 1970s, Mexico suffered from a chronic shortage of physicians. Starting in 1967, however, the medical education system experienced an explosive expansion. Student enrollment peaked in 1980 at 93,365, compared to 28,731 in 1970;[5] the number of medical schools reached 56 in 1979, up from 27 in 1970.[6] The underlying causes for this growth process are very complex and have been analyzed in detail elsewhere*. Briefly, two factors appear to be crucial: the increased demand for higher education from the middle classes, and the effects of the economic crisis that has intermittently affected Mexico since the mid-1970s and has channeled a large number of young people who cannot find employment in the general labor market into the universities.

The economic crisis also produced a reduced rate of growth of medical services, which made it impossible for the health care system to absorb the increased number of graduates. As a consequence, new phenomena of un- and underemploy-

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*Frenk J: The political economy of medical underemployment in Mexico: Corporatism, economic crisis, and reform. Presented at the Conference on the Political Dynamics of Physician Manpower Policy, London, England, May 24–27, 1988.

TABLE 1—Recent Evolution of Physician Supply in Mexico

Year	Absolute Number of Physicians	Physicians per 100,000 Population
1960	20,590	57
1970	34,107	71
1985	120,000	153

Sources:
For 1960: Ref. 7
For 1970: Ref. 8
For 1985: Ref. 9

ment began to characterize the medical labor market. Table 1 indicates that the supply of doctors in Mexico grew 2.7 times between 1960 and 1985.[7-9] It has been estimated that until 1971 every physician could find a salaried position upon graduation; by 1984 four graduates had to compete for every job in a health care organization.[10]

In addition, the number of positions for postgraduate residencies has remained practically constant throughout this period, at about 2,000 new positions per year. This means that the point of selection has been transferred from the medical school to the specialty residency, where entry is regulated by a uniform national examination, so that the competition for such positions has become fierce.

Since 1979 there has been a sustained effort to curb the growth of the medical education system, mostly through the institution of a joint decision-making body that brings together representatives from both the universities and the health sector.[11] As a result, only three new medical schools have been created in the past 10 years, and the annual number of graduates, which peaked at 14,099 in 1983, has declined steadily.[7] Nevertheless, the momentum of the physician population that was produced by the high growth rates of the 1970s explains why unemployment and underemployment have remained high.

Despite their visibility in the media, the magnitude of these imbalances has not been quantified with precision up to now. Estimates vary widely according to the interests represented by each source. In order to provide a scientifically validated picture of the employment situation of doctors, we conducted a national survey in 1986. Apart from its descriptive purpose, the survey also had the objective of exploring variables that may account for the performance of physicians in the labor market.

Methods

Data Source

Because the purpose of the study was to analyze the full range of employment possibilities, including the lack of a stable job, it was obvious that we could not draw a sample of traditional sites of medical work, such as offices and hospitals. Instead, we needed a representative sample of households where those holding a medical degree lived.

Such a sample was obtained from the 41,000 households that are visited every three months by the National Survey of Urban Employment, which is the official source of most labor statistics in Mexico and is carried out by the National Institute of Statistics, Geography, and Informatics. This survey covers the 12 metropolitan areas in the country and the four most important cities on the United States-Mexico border. It is a rotating panel survey, based on a stratified, multistage sample of households, where 88,050 people, representing 14,529,826 inhabitants ages 20 years or more, are interviewed. The validity and reliability of this survey have been extensively documented throughout the 17 years during which it has been in existence. Further details can be consulted in official publications on the survey.** Although this is a complex probability sample,[12] physicians constitute a relatively rare element in it; under these circumstances we assumed that they behave as a simple random sample, so that no weighting of the data is necessary in the analysis.[13]

In the last trimester of 1985, 620 physicians were identified during the regular round of the National Survey of Urban Employment. Shortly thereafter, these doctors were reinterviewed in face-to-face sessions by professional interviewers, who used a questionnaire specifically designed for our study at the National Institute of Public Health. The entire process of interviewing and coding was supervised by researchers from this institute.

Complete questionnaires were obtained from 604 physicians, for an overall response rate of 97 percent, which ranged from 94 percent in one city to 100 percent in eight cities. In Mexico future physicians are required, after four years of medical school, to complete a one-year internship in a hospital and one additional year of "social service" in a rural area before receiving their medical degrees. The sample included these interns and social service practitioners in addition to physicians who had already obtained their degrees. However, the present analysis is based on the 491 physicians who were active in the labor market. The "inactive" doctors excluded from the analysis comprise retired persons, as well as interns and social service practitioners, who do not demand employment since they are assured those positions in order to comply with the requirements for a medical degree.

Variables

Social Origin—This reflects not only the general standard of living that the physician enjoyed while he/she was growing up, but also the access to networks of relationships that may create future job opportunities. Social origin was measured through an index based on the occupation of the person who supported the physician during his/her years as a medical student (typically the father). The resulting categories were: low (e.g. manual workers, small-scale merchants), middle (e.g. technicians, teachers, clerical workers, foremen, sales agents, mid-sized merchants), and high (e.g. owners of industry, senior managers, senior government officials, professionals). In order to validate this index, we used the 1980 Census data to rank occupations along an income scale that was divided into three equal parts. The data on fathers' occupations from our survey were then matched to the Census occupation information. There was 100 percent match between our three categories of social origin and the three segments of the income scale.

Gender—Apart from its effects on productivity and job stability, gender is thought to be associated with differential access to occupational positions even af-

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**Instituto Nacional de Estadística, Geografía e Informática: Encuesta Nacional de Empleo Urbano: Diseño Muestral. Aguascalientes, México, December 1987.

ter educational opportunities have become more equal among women and men.

Medical School Quality—It cannot be assumed that attending a medical school represents the same educational experience for everyone. The only objective indicator of quality available for all medical schools in Mexico is a standard examination applied to graduates at the end of their studies in order to select those who will be admitted into a residency. However, this standard test has only been in existence since the mid-1970s, so that no comparable quantitative data are available for physicians who studied earlier. For this reason, we measured quality through an opinion poll from 30 experts in medical education selected to represent four groups: authorities from medical schools, decision makers from the main health institutions in charge of medical manpower, faculty members from medical schools, and academics who have studied various aspects of medical education. Experts were given a standardized schedule to rate the quality of schools, taking into consideration elements of structure (e.g. number and qualifications of the faculty, adequacy of the facilities), process (e.g. type of curriculum, educational methodology), and outcomes (e.g. competence of graduates, success in finding jobs). They were asked to provide separate evaluations for two time periods: before and after 1970, since it cannot be assumed that the quality of the schools existing before 1970 has remained constant. Evaluations for each school in each time period were made on a scale from 1 to 4, and the scores were weighted according to the amount of information that the experts declared themselves to have about each assessment. The quality index was the average of these weighted scores. Its distribution revealed two marked cleavages, which were used as cutoff points to stratify schools into three categories of quality: inadequate, average, and good. The validity of the quality index for schools after 1971 was checked by correlating it with the average scores of graduates from each school on the standard examination for admission into residencies. The Pearson r correlation was 0.76, which was considered satisfactory.

Type of Specialty—This variable reflects the differential access to opportunities for postgraduate education. It also indicates the intensity of specialization, as measured through the following categories: no specialty, family medicine, basic specialties (i.e. internal medicine, pediatrics, gynecology-obstetrics, and general surgery), and subspecialties. Even though in Mexico the length of postgraduate training is similar for family medicine and for the basic specialties, the former is considered to represent a lower degree of specialization, since family practitioners are trained to deal with all age and sex groups. In addition, the practice settings are also different. Family medicine emerged during the 1970s as a residency program aimed at satisfying the requirements for first-contact care at the social security and other public-sector organizations. Thus, family doctors practice almost exclusively in ambulatory settings, while basic specialists also work in general hospitals.

Generation—To consider the influence of contextual variables, such as the situation of the medical labor market, we measured a variable called generation, which refers to the year in which the physician entered medical school, whether before or after 1971, the year when the policy of massive access to higher education was fully implemented. In addition to reflecting the environment to which the physician was exposed during his/her formative years, generation is very highly correlated (Pearson's r = 0.97) with age. In turn, age is related to experience, productivity, and exposure to employment opportunities, all of which affect the success of a physician in obtaining a desirable job.

Even though the data come from a cross-sectional survey, the fact that there is an unambiguous chronological order among the variables allows us to adopt a "biographical" view of medical employment. In this time order, three of our independent variables can be considered antecedent to the others, i.e. social origin, gender, and generation/age. In turn, attending a medical school occurs before postgraduate training to become a specialist. The final link in this chain, which represents the dependent variable, is medical employment.

Dependent Variable—We conceptualize the dependent variable as "medical employment pattern," built through cluster analysis of physicians sharing similar job characteristics. The detailed statistical procedure has been described elsewhere.[14] The final variable summarizes the most relevant dimensions of employment: number of jobs; position (salaried or independent); occupational level (whether the job requires less skill than what the person was trained for, e.g. whether the physician performs a nonmedical job); productivity (measured by the number of patients seen and hours worked per week); income; and job stability.

Obviously, the number of potential combinations is very large. Cluster analysis enabled us to ascertain the specific combinations that occur empirically. These combinations were grouped to form the dominant patterns, which turned out to be six:

1. Unemployment: This category was strictly defined to include those doctors who did nothing but search for a job or who had stopped looking for one because they had become discouraged.

2. Qualitative Underemployment: This pattern refers to physicians who worked outside medicine. Even if they may have had high productivity or income, the social investment in their medical education would have been underutilized. As it turned out, most of these jobs required a lower level of training than medical care.

3. Quantitative Underemployment: Our analysis identified a cluster formed by physicians who provided patient care, but did so under one or more negative circumstances suggesting that their work potential was severely underutilized.[15] As shown in Table 2, doctors in this cluster saw very few patients (the mean for the cluster was 18.2 patients per week, compared to 66.1 among all other physicians in patient care), worked reduced hours (a mean of 31.9 hours, compared to 55.3 among the rest of physicians, with 60 percent of underemployed doctors working less than 35 hours per week), and/or earned a low income (54 percent made less than three minimum wages, compared to 18 percent among fully employed doctors). In addition, these physicians tended to have unstable working conditions, characterized by job insecurity and high turnover rates.

4. Salaried Single Medical Employment: This is a conventional pattern composed of doctors with one stable salaried job in a health care organization, most often in the public sector.

5. Independent Single Medical Employment: This cluster represents another conventional pattern, wherein physicians work full time in their own private practices. In terms of income, this was a more heterogeneous cluster than the previous one; as shown in Table 2, the percentages in the lower end of the distribution were similar among both clusters with single employment, but independent doctors exhibited a much higher proportion of high-income earners. Such heterogeneity also accounts for the smaller average produc-

TABLE 2—Average Productivity and Income for Medical Employment Patterns Involving Patient Care

Medical Employment Patterns Involving Patient Care	Productivity: Mean number of patients seen per week	Productivity: Mean number of hours worked per week	Income: Percentage earning less than 3 minimum wages	Income: Percentage earning more than 5 minimum wages
			%	%
Salaried single employment	65.4	60.1	25	35
Independent single employment	27.9	36.7	24	53
Multiple employment	83.8	57.1	5	84
Quantitative underemployment	18.2	31.9	54	19

TABLE 3—Relationships between Medical Employment Pattern and Each of the Independent Variables

	Independent Variables															
	Generation		Gender		Social Origin			Medical School Quality			Type of Specialty				Total	
Medical Employment Pattern	1920–70 %	1971–82 %	Male %	Female %	Low %	Middle %	High %	Inadequate %	Average %	Good %	Without Specialty %	Family Medicine %	Basic Specialties %	Subspecialties %	%	N
Salaried single employment	27	41	32	45	37	38	25	33	38	32	25	83	37	39	34	169
Independent single employment	16	7	13	4	11	11	12	11	11	11	15	0	5	11	11	55
Multiple employment	42	10	30	9	20	27	33	9	27	40	14	15	48	41	26	126
Quantitative underemployment	6	15	9	15	10	11	12	18	9	6	15	0	8	5	11	52
Qualitative underemployment	7	14	11	10	11	9	11	14	10	9	18	2	1	3	11	52
Unemployment	2	13	5	17	11	4	7	15	5	2	13	0	1	1	7	37
Total %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
N	235	256	391	100	197	180	114	158	166	167	262	41	89	99		491
X^2	98.5		40.8		16.9			65.4			159.4					
p	0.0001		0.0001		0.0759			0.0001			0.0001					
Cramer's V	0.45		0.29		0.13			0.26			0.32					

tivity, since competition probably forces some independent physicians into the lower end of the distribution.

6. *Multiple Medical Employment:* This last pattern included cases holding two or more medical positions, the majority of them with one salaried and one independent job. In the Mexican medical labor market, as in many other developing countries, such a dual pattern has been traditionally considered to be very desirable, since it allows the physician to combine the prestige of a position in a public hospital with the economic incentives of a private practice. The advantages of this situation can be appreciated in the productivity and income figures presented in Table 2.

Analysis

The purposes of the analysis were to measure the frequency of each medical employment pattern, to determine the links among the variables, and to compare the relative strength of each relationship. In order to achieve this last purpose, we used percentage differences, as well as two conventional measures of association for cross-tabulations, namely, Cramer's V when the measurement level of the variables was nominal and Gamma when it was ordinal.[16–18]

Results

Table 3 presents a set of cross-tabulations between pairs of variables. The marginal totals provide the frequency distribution of employment patterns, and the percentages can be interpreted as employment rates. Thus, the unemployment rate is 7 percent, while the global underemployment rate (quantitative and qualitative) is 22 percent. Projecting these proportions, we can infer from the population of active physicians in the 16 cities (81,024) that un- and underemployment affect approximately 23,500 doctors.

Moving to the correlates of this problem, Table 3 indicates that all the explanatory variables, except social origin, exhibit significant and fairly strong overall associations with employment pattern. Beyond these common characteristics, it is worthwhile to examine each cross-tabulation.

Generation

Table 3 shows a marked increase in unemployment and underemployment from the oldest to the youngest group. Among those who do have a job, there is a shift from independent to salaried practice and from multiple to single employment. This variable reflects not only the intrinsic differences between the two generations, but also the different time spans that each group has been in the labor market. In addition, the sample may be biased for the older generation insofar as we only have the survivors. Nevertheless, the trends exhibited by our data are consistent with existing information about the supply and demand of physician manpower.

Gender

There is an important connection between generation and gender, since the proportion of women among physicians was 14 percent in the 1920–70 generation and 26 percent in 1971–86. As can be seen in Table 3, the proportion of unemployed women is three times higher than the corresponding figure for men. Although salaried single employment is the most important pattern for both groups, the second most important pattern is multiple employment among men and unemployment among women.

Social Origin

There is a tendency for multiple medical employment to be more frequent with higher social origin. Conversely, salaried single employment is not as important in the high group as it is in the other two, and unemployment is most frequent among physicians from the lowest socioeconomic background.

Medical School Quality

There is a marked descending gradient for the least desirable patterns as quality increases: 47 percent of physicians who studied at an inadequate school are un- or underemployed, compared to 24 percent and 17 percent of graduates from average and good schools, respectively. It is also worth noting that higher quality is associated with increasing proportions of multiple medical employment. This is the dominant pattern for physicians from the better schools, whereas salaried single employment is the most common pattern for inadequate and average schools.

Type of Specialty

Lack of postgraduate training greatly increases the chances of un- or underemployment: almost half of the physicians without a specialty are located in one of these categories. The practice of family medicine has become the prototype of medical work based on a single salary at the service of the state, with 83 percent of family doctors exhibiting such a pattern. The traditional pattern of multiple employment is now reserved for physicians with a basic specialty or a subspecialty, among whom unemployment is very rare.

Some of the effects shown in Table 3 could be indirect, as mediated by chronologically subsequent variables. In the case of gender, there were no significant differences between men and women in the quality of the medical school attended, but their respective opportunities for postgraduate training presented sharp contrasts. Thus, when specialty is examined by sex, we find that more than two-thirds of female doctors have no specialty, compared to less than half of their male colleagues (Table 4). Among those who do complete a residency, the proportions of men and women are about equal in family medicine. However, males dominate in the basic specialties and even more so in the subspecialties, where their proportion is twice that of females.

Social origin could also affect employment indirectly, through a relationship that is mediated by medical school. As shown in Table 5, the association between social origin and medical school is fairly strong. Thus, 40 percent of physicians from the lower social origin attended an inadequate medical school, compared with 44 percent of doctors from the higher social origin who went to a good school.

Part of the effect of medical school quality on employment may be mediated by type of speciality, since entrance to a residency is a competitive process that is bound to be affected by the quality of previous education. Table 6 demonstrates that there is a strong association between medical school quality and type of specialty. The likelihood of having no specialty increases consistently as quality decreases. Thus, the proportion of general practitioners is 1.4 and 2.2 times larger among graduates of inadequate schools than among doctors who studied at average or good schools, respectively. In contrast, good schools concentrate the highest proportions of basic specialists and subspecialists. In fact, we can consider the high degree of consistency of this association as a confirmation of the validity of our measure of school quality.

Discussion

The results of this study point to a series of imbalances, inadequacies, and inequities that characterize the medical labor market in Mexico. First of all, the heavy burden on Mexican society: almost one-third of all physicians living in the 16 major cities are unemployed or underemployed. Because these extreme forms of imbalance are likely to be concentrated in the large cities, the situation probably approaches the total for the whole country. In any event, the figure of 23,500 unemployed and underemployed physicians acquires its precise meaning when one considers that in 1986, the year when our survey was conducted, 9.3 million people, representing 11 percent of the Mexican population, did not have ready access to health services.[19]

TABLE 4—Type of Specialty by Gender

Type of Specialty	Gender Female %	 Male %
Without specialty	69	49
Family medicine	9	8
Basic specialties	11	20
Subspecialties	11	23
Total	100	100
N	100	391

$X^2 = 14.56$ $p = 0.0022$ Gamma = 0.36

Not all types of imbalance produce the same social impact. Unemployment and qualitative underemployment represent a waste of resources for society and a source of frustration for those doctors who have to work outside medicine or cannot find a job at all. Paradoxically, even those who are unemployed seem unwilling to serve in deprived rural areas, indicating that they would rather remain in the cities than be fully employed as physicians where their services are most needed.[20]

While unemployment and qualitative underemployment are undoubtedly severe problems, quantitative underemployment opens up a new perspective on physician oversupply. In this case, doctors still provide patient care, but do so at low levels of productivity. It is not unreasonable to assume that such doctors may represent a potential risk to their patients. Our analysis indicates that physicians with

TABLE [illegible]—Quality of the Medical School Attended, by Social Origin of the Physician

Medical School Quality	Social Origin Low %	 Middle %	 High %
Inadequate	40	28	25
Average	36	34	31
Good	24	38	44
Total	100	100	100
N	197	180	114

$X^2 = 17.22$ $p = 0.0018$ Gamma = 0.24

TABLE 6—Type of Specialty, by Quality of the Medical School Attended

	Medical School Quality		
Type of Specialty	Inadequate %	Average %	Good %
Without specialty	75	52	34
Family medicine	6	9	9
Basic specialties	10	19	26
Subspecialties	9	20	31
Total	100	100	100
N	158	166	167

$X^2 = 58.97$ $p = 0.0001$ Gamma = 0.45

low output tend to be young, have no postgraduate training, and often work in independent practices without any supervision. Under these circumstances, the quality of care may suffer through two mechanisms: first, doctors who see few patients may be unable to build up enough clinical experience; second, there may be a tendency to overprescribe medical procedures in order to derive a living from those few patients. The extent to which quantitative underemployment of doctors may represent a health risk is a subject for future research.

The appearance of imbalances also suggests that the medical labor market is experiencing a process of segmentation.[21] Apart from those physicians who are out of a medical job, there seem to be two major segments. The first one is characterized by reasonable productivity, relatively sufficient earnings, and stable employment conditions through a salaried position in government, a conventional private practice, or both. Diverging from the mainstream, a substantial number of doctors have entered into a marginal segment of the market, which is characterized by low productivity, insufficient earnings, and occupational instability. The segmentation process even extends to those who have attained relatively good positions, as illustrated by the fact that the traditional prestigious pattern of combining a salaried position in the public sector with a private practice is now dominated by physicians with a basic specialty or a subspecialty; in contrast, family doctors exemplify a new kind of medical functionary, since the vast majority of them hold their only job at the service of the government.

These cleavages in the medical profession reflect a broader process leading the medical education and health care systems to reproduce, rather than ameliorate, pre-existing social inequalities. Such a process begins with the channeling of students from different social origins to medical schools of varying quality. Indeed, the data reported here have demonstrated that there is a substantial degree of social stratification among medical schools, thus corroborating the findings from a previous study.[22] In turn, the quality of the medical school affects the probability of doing a specialty residency, which has a direct effect on employment. To complete this logic, we can assume that underemployed physicians are more likely to care for people from the lower social classes. There are reasons to believe that the quality of the care provided by these physicians is inadequate. In addition, there is empirical evidence that the distribution of the quality of care in Mexico is highly stratified by social class.[23] A circle is therefore closed: disadvantaged people will attend substandard medical schools and end up providing inferior care for other disadvantaged people. Obviously, this is not a deterministic but a probabilistic sequence of events. Indeed, we are not dealing with a rigid social structure that prescribes these patterns of behavior, but with one that tends to reproduce inequality. Although many individuals can and do escape from this vicious cycle, its existence seriously threatens the legitimacy of higher education and of health care.

The distribution of employment patterns by gender also exhibits important elements of inequality. In contrast to social origin, there is no stratification of medical schools by gender. Yet disparities are found in the opportunities for postgraduate residency, as shown by our data. Most of the substantial gender differentials in employment patterns can be attributed to the mediating effect of access to residencies. Such differentials acquire additional importance when one considers that the proportion of women in the medical profession is increasing. For example, by 1985 women constituted half the entering class at the most important medical school in the country, up from 38 percent in 1979.[24]

Despite their many sobering implications, our findings still leave ample room for policy interventions to correct imbalances. Many of the effects on employment appear to be mediated by the quality of medical schools and the opportunities for postgraduate training. Thus, actions can be implemented to improve inadequate schools and to make admissions dependent on academic potential only and not on the economic status of the student's family. Similarly, residency programs can adopt affirmative action measures that give women equal opportunities based solely on qualifications. In particular, it seems necessary to provide support services that will make the pursuit of a medical career compatible with other social roles.

With respect to those physicians who are already un- or underemployed, it would seem urgent to adopt continuing education programs that may compensate deficiencies in previous training and encourage those physicians to serve in rural areas. Such educational endeavors would have to be complemented by specific incentives, both in monetary terms and in opportunities for future career advancement. The ultimate obligation of protecting the health of the population also makes it necessary to consider mechanisms for the periodic certification of medical competence.

Finally, current effects to restrict the growth of medical schools must continue. Indeed, there can be little doubt that an overabundance of physicians has dysfunctional consequences not only for the medical profession itself, but also for the health system as a whole, including the users of services.

Above all, countries like Mexico must make explicit efforts to redress the inequities that still mar the systems of higher education and health care. The French sociologist Raymond Boudon spoke of "perverse effects" as an analytic category that accounts for the actual functioning of many social institutions.[25] Higher education and health care, two of the fundamental vehicles for promoting equity, are at risk of falling into the perverse effect of reproducing social inequalities. Unless they truly fulfill their role of ameliorating the negative consequences of poverty, they may themselves end up being impoverished institutions. The challenge, in essence, is to harmonize the legitimate aspirations for social advancement through higher education with the imperative of improving the well-being of the population. □

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Why Do Child Mortality Rates Fall? An Analysis of the Nicaraguan Experience

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ABSTRACT

A comprehensive review of available sources of mortality data was undertaken to document the changes that have occurred in infant mortality in Nicaragua over the last three decades. It was found that a rapid fall in infant mortality commenced in the early 1970s and has continued steadily since. Trends in several different factors which might have led to this breakthrough were examined including: income, nutrition, breastfeeding practices, maternal education, immunizations, access to health services, provision of water supplies and sanitation, and anti-malarial programs. Of these, improved access to health services appears to have been the most important factor. At a time when the number of hospital beds per capita was dropping, increasing numbers of health care professionals, particularly nurses, were becoming available to staff primary health care facilities built in the 1960s. These were provided at least partly in response to the growing political turmoil enveloping the nation at that time. Certain Nicaraguan cultural attributes may have added to the impact of the reforms. Efforts in the field of public health made since the 1979 insurrection appear to have maintained the decline in child mortality. (*Am J Public Health* 1991; 81:30–37)

Introduction

Poor child health in developing countries continues to be a source of concern.[1] In recent years it has become apparent that while poverty is probably the major factor affecting survival in the early years of life, there are undoubtedly other influences playing an important role. Some countries, in spite of a low per capita gross national product, have succeeded in achieving mortality levels close or equal to those of the industrialized world. In contrast, there are others with poor levels of child health despite enjoying relatively high per capita incomes.[2] Efforts have recently been made to identify the factors beside socioeconomic status which are determinants of infant mortality. In 1985, the Rockefeller Foundation sponsored a conference which studied the striking mortality reductions in Kerala State (India), Sri Lanka, Costa Rica, and China.[3] In each case, mortality has fallen sharply over a relatively short period leading to high life expectancy relative to national income. Seven conditions were purported to be essential to the observed improvements: female autonomy, education (especially female), the provision of accessible health services, a mechanism to guarantee the efficient operation of health services, an adequate minimal standard of nutrition, universal immunization, and a commitment to the establishment of effective antenatal and obstetric services.[2]

Nicaragua is another country which has experienced a recent breakthrough in child mortality. This article describes that breakthrough and looks at its relationship with some of the factors alleged to be important determinants of child mortality. It is hoped this work serve as a model for the type of intersectoral data analysis advocated recently by de Kadt.[4]

Methods

Seven different sources of data were identified which could provide time-located estimates of infant mortality in Nicaragua from 1960 to 1986.[5–11] A brief description of each source of data is given in the Appendix. Except for data obtained from the Civil Register, the infant mortality estimates were derived using the Brass technique based on the ratio of surviving to ever born children of mothers classified by five-year age group. The rationale behind this method is that the proportions dead of ever born children for women of a certain age correspond to discreet child survival probabilities. These survival probabilities can be used to calculate infant mortality rates (IMRs) if one assumes a typical age pattern of mortality. In this case the Coale-Demeny 'West' model of mortality was used.[12]

Variations of the Brass method have been developed which allow the estimation of trends in mortality change, recognizing that the deaths in children born to

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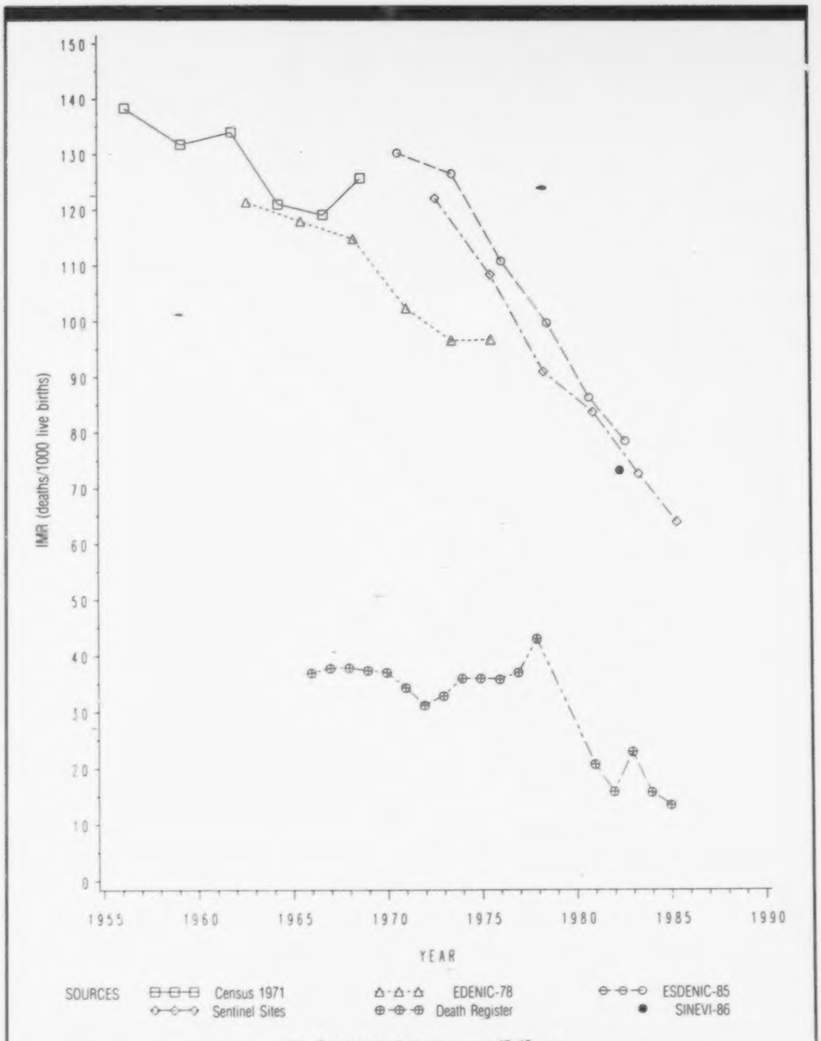


FIGURE 1—The trend in Nicaraguan infant mortality by data source, 1956–86

women ages 15–19 years have occurred more recently than the deaths in children of women ages 45–49. The Trussell method, which was employed in this analysis is one such variant.[13] It provides time locations for the infant mortality estimates obtained from each five-year age group of mothers.

Estimates of infant mortality from the death register were calculated by dividing the number of deaths registered in each year by the projected population under the age of one. Death registration is well known to be variable and incomplete so these figures were not used in further calculations. However, the relatively low rate of omission for birth registration allows a more accurate estimation of the IMR by asking about the survival of preceding births at the time of registration. The data for 1986 (SINEVI-86) were analyzed in this way by the Centro Latino-Americano de Demografía (CELADE).[11]

There are a number of factors which are believed to be important determinants of child mortality. These include: income, nutrition, maternal education, breastfeeding, immunization coverage, the provision of health services, access to water supplies and sanitation, malaria control, as well as certain cultural attributes of the population. Trends in these factors were examined and related to the observed changes in infant mortality in Nicaragua from 1960 to 1989. Wherever possible, data were obtained from the original sources in Nicaragua by visiting libraries and documentation centers in government ministries and institutions.

Data on per capita Gross National Product (GNP) were obtained from an analysis performed by the National Autonomous University of Nicaragua.[14] It was not possible to accurately quantify changes in income distribution.

An assessment of trends in child nutritional status was based on three surveys on nationwide samples of children in 1966, 1977–8, and 1986.[15–17] Height for age was used as the indicator of nutritional status as it was the only one measured in all three surveys. In two of the surveys,[15,16] the children measured were under the age of 5, in the third they were school children ages 6–9 years. Figures for food production and caloric intake were derived from World Bank[18] and United Nations Food and Agricultural Organization[19] statistics, respectively. The frequency of breastfeeding in 1977 and 1988 was estimated from two ad hoc surveys performed in Managua.[20,21]

Levels of illiteracy in Nicaragua were obtained from the censuses of 1950,[22] 1963,[23] and 1971[5] and from the EDENIC-78 and ESDENIC-85 surveys.[11] Rates were calculated for the total population ages 10 years and over, for the urban and rural populations, and for women ages 15–44 years.

An analysis of Ministry of Health cause of death statistics by CELADE documents changes in death rates in children due to immuno-preventable diseases.[11] These were compared with an indicator of vaccination coverage, estimated by dividing the Ministry of Health figures for the annual number of inoculations by the population of children under the age of five for that year.

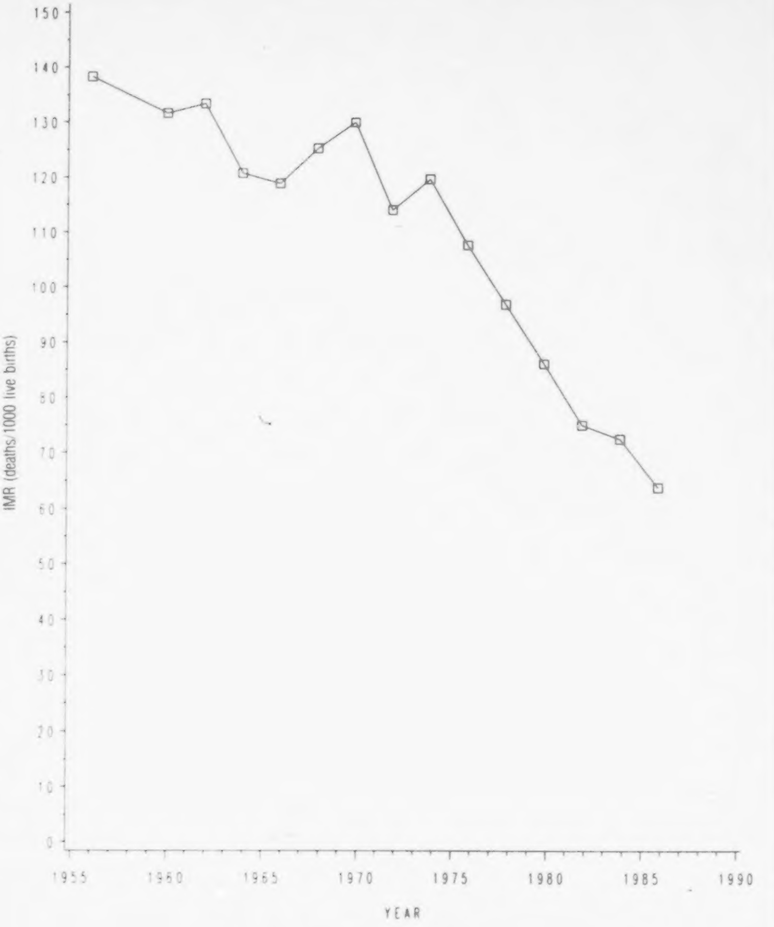
There have been several analyses of Nicaragua's health system, mostly comparing the situation before and after the 1979 insurrection.[24–27] These were reviewed and combined with statistics from the health sector[10,28–30] (public and private) to obtain an overview of the trends in the provision of health services—both as infrastructure and as human resources—from 1960 to 1985.

National statistics were used to determine what changes had taken place in domestic water supply and sanitation facilities.[10,30] Figures for latrine construction were taken from Ministry of Health records.[28] An analysis by Garfield and Vermund[31] and national records of laboratory tests for malaria were used to look at trends in the incidence of malaria.

Results

Infant Mortality Estimates

Figure 1 shows the infant mortality estimates from each of the aforemen-



Sources: Census 1971, EDENIC-78, ESDENIC-85, SINEVI-86, Sentinel Sites 1988

FIGURE 2—The trend in Nicaraguan infant mortality: 1956–86 (weighted averages)

tioned sources plotted against time. Estimates from ESDENIC-85, SINEVI-86 and the 1971 Census, the three largest databases, give a consistent profile of the trend in mortality. Moreover, the IMRs from the sentinel sites study agree remarkably well with those of ESDENIC-85. There is some divergence in the mortality estimates from EDENIC-78, particularly for the early 1970s but these are based on data from a small number of women and hence this may be due to sampling error. The rates calculated from death registration are incompatible with the other estimates, a reflection of gross inadequacies in coverage of this system. They are not used in further analyses.

A weighted average of infant mortality estimates from the 1971 census, the EDENIC-78 and ESDENIC-85 surveys, the SINEVI-86 analysis of birth registration and the sentinel sites study was made for each two-year interval. Rates obtained from women ages 15–19 years were not included as these are well known to be unreliable.[13] The results are plotted in Figure 2. Figure 3 presents the same data plotted on a logarithmic scale which more appropriately portrays the change in the rate of decline. Taken as a whole, the studies indicate that the rate of fall in infant mortality, which was slow in the 1960s, increased sharply in the early 1970s, and that this rapid decline was still continuing in 1986. The infant mortality rate drops on average by 4.7 deaths per 1,000 live births for each year from 1974 to 1986. Assuming a 'West' mortality schedule, this is equivalent to an annual increase in life expectancy of 0.75 years each year over this 12-year period.

Figure 4 presents urban and rural IMRs from the 1971 Census and ESDENIC-85. Changes in the definitions of 'urban' and 'rural' and internal migration make interpretation difficult but there is no clear evidence that in Nicaragua the breakthrough was more pronounced in rural areas than in urban areas.

Differential infant mortality rates according to levels of maternal education are provided by the CELADE analysis. In the three time periods examined—1966–67, 1973–74, and 1982–83—infant mortality rates for mothers with secondary or higher education were considerably lower than for mothers with primary or no formal education. The results suggested that this differential narrowed over the period in question (data not shown).

Explanations for the Decline in Child Mortality

How can this sharp drop in child mortality be explained? In the first place, it should be recognized that more than one factor may be involved. The reason that mortality started to fall may be different from the reason that it continues to fall. Since this is not a controlled experiment, causes can easily be confused with effects, and one is always left in doubt as to what would have happened in a different set of circumstances. Nevertheless, the Nicaraguan case has some very interesting features which make it worth examining in greater detail.

Income—The observed infant mortality decline in Nicaragua does not correspond to a rise in general living standards. Per capita GNP rose rapidly in the early 1960s but flattened off in the 1970s before falling sharply in the 1980s. This fall may have been offset somewhat by a more equal distribution of wealth following the insurrection (as a result of the wages policy, food subsidies and rationing, price controls, and rent controls), but there are insufficient data to quantify changes in income distribution over this period.

Nutrition—In 1966, 36 percent of children under the age of 5 were found to be below two standard deviations in the reference range for height for age. In the survey performed from 1977 to 1978, 26 percent of children under the age of 5 were below two standard deviations for height for age and in 1986 the corresponding prevalence of stunting in first grade school children (ages 6–9 years) was 22 percent. Although Nicaragua has high rates of primary school attendance, poor children tend to start later than the rest. This produced an age bias in the results of the 1986 survey such that in 6-year-old first grade children the prevalence of low height for

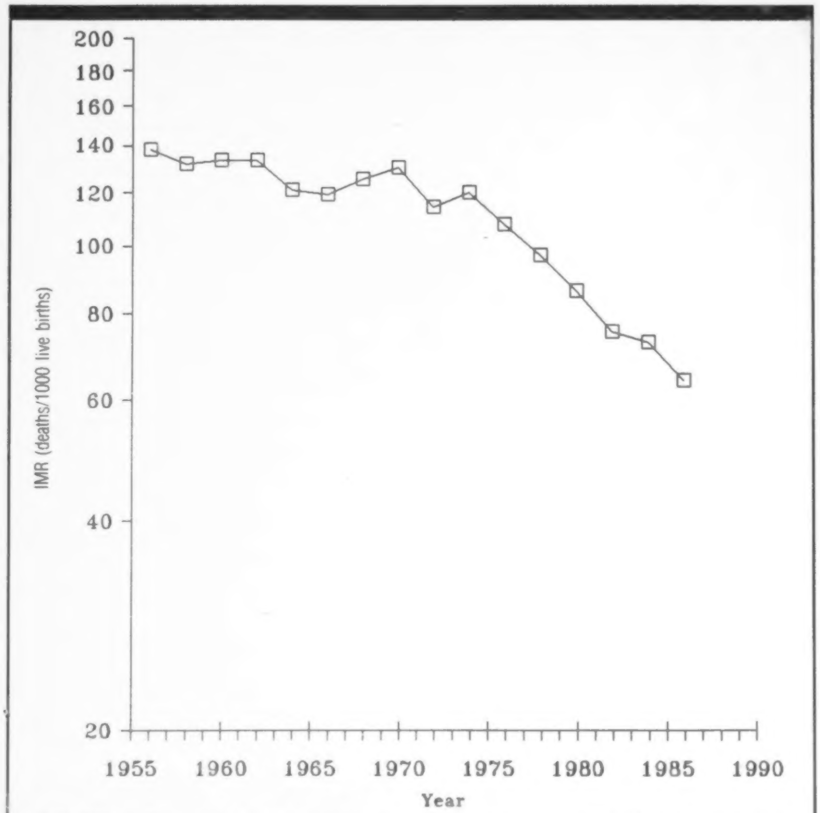


FIGURE 3—The trend in Nicaraguan infant mortality: 1956–86 (weighted averages) plotted on a logarithmic scale (base 10)

age was only 14.5 percent compared with 32.7 percent for 9-year-old first grade pupils.

Despite the deficiencies in the available data, it would seem reasonable to conclude that nutritional status in Nicaraguan children improved steadily from 1966 to 1986, but the factors leading to this improvement are uncertain. Food production in 1986 was only 70 percent of what it was in 1967 having fallen sharply from its peak in 1978. The number of food calories per head of population dropped from 2,410 in 1970 to 2,344 in 1975 and then to 2,258 in 1980, recovering slightly by 1983 to 2,304.

On the other hand, a variety of programs and activities aimed at improving child nutrition already existed in 1970.[32] These were expanded in 1973 in response to the threat posed by the 1971 drought and the 1972 earthquake. A milk distribution program of the Ministry of Public Health was in operation since the 1960s but was gradually abandoned in the late 1970s. It was recommended for several years following the 1979 insurrection along with other policies aimed at establishing an adequate nutritional standard. These included food subsidies, rationing, and supplementary feeding programs for pregnant women and malnourished children.

Breastfeeding—The limited data available suggest that there has been no increase, and perhaps a decrease occurred in the average duration of breastfeeding in Nicaragua over the period of rapidly declining child mortality. In 1977, 58 percent of mothers in Managua were breastfeeding their children for at least six months. In 1988, only 33 percent of children between three and five months of age were still receiving breast milk.

Maternal Education—The changes in the rate of illiteracy in Nicaragua are summarized in Table 1. The tendency has been for illiteracy to decrease throughout the period from 1950 to 1985. The overall drop in illiteracy is greater than the individual falls in urban and rural areas because of migration to the town and cities. The slowest rate of change in the overall prevalence of illiteracy was observed between 1971 and 1978. Between 1978 and 1985 there was a marked drop in the prevalence of illiteracy, mainly as a consequence of the 1980 National Literacy Crusade and the extensive adult education program which followed.

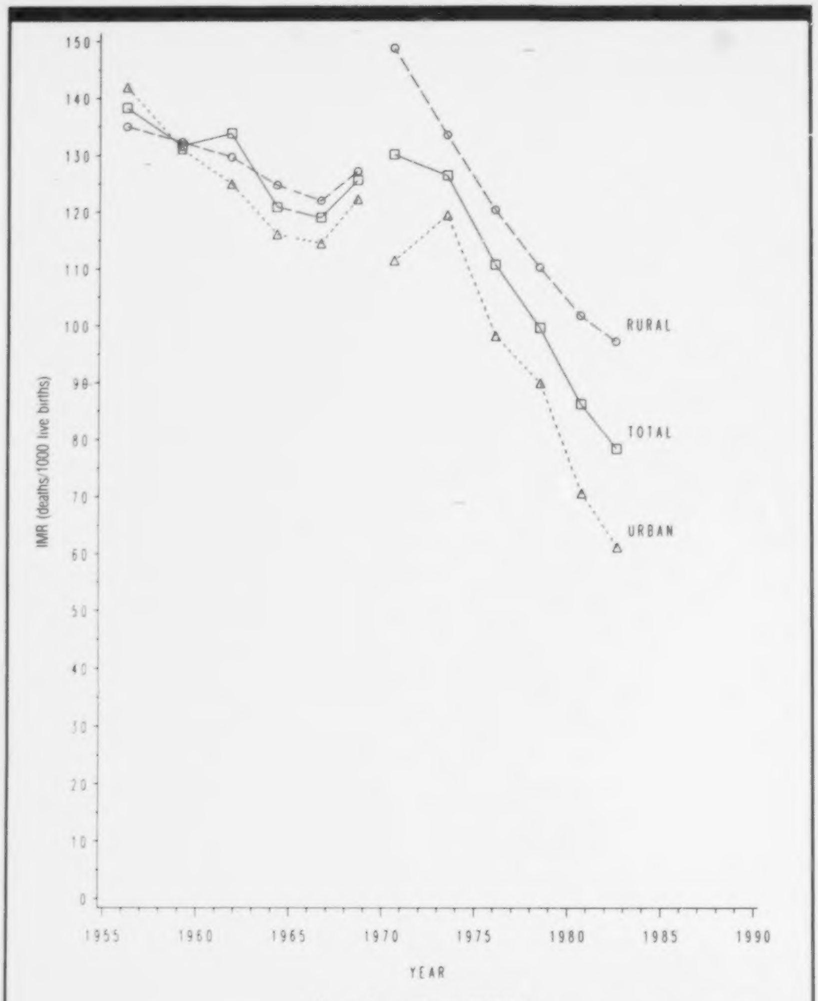
Immunizations—Mortality due to diseases preventable by immunization in the ages 1–4 dropped from 21 per 10,000 in 1975 to 3 per 10,000 in 1986 (or from 17 percent to 4 percent as a proportion of total mortality in this age group). Unfortunately, the poor quality of the statistics did not permit a similar analysis for children under one year of age.

Table 2 shows the change in rates of immunization over the period from 1970 to 1985. Prior to 1979 rates of vaccination coverage varied widely as periodic campaigns were launched in response to cyclic epidemics of immuno-preventable disease. Since 1979 coverage has been higher and shown less variation. The participation in massive nationwide vaccination campaigns of large numbers of voluntary health workers in the years immediately following the insurrection was probably the main factor in this improvement.

Health Services—In comparison with other developing countries, Nicaragua's health system suffered more from maldistribution of resources than from a lack of investment. Health service infrastructure and personnel were concentrated in the cities and particularly in the capital. In the 1960s and 1970s, efforts were made to redress this imbalance and improve access to health care. A USAID loan of $US 2.2 million was received in 1965 to set up 55 health centers and provide outreach programs in rural areas. By 1974 there were 33 hospitals, 93 health centers and 38 health posts spread throughout the country, and the Rural Mobile Health Program provided care to remote areas. More primary health care facilities were built in the first years following the insurrection.

Although considerable infrastructure was already installed by 1973, an evaluation of the 55 health centers built from USAID loan found low utilization rates owing to the lack of personnel, supplies, and management support. Two further USAID grants were made in the mid-1970s to correct these deficiencies.

In contrast to the growth in primary health care facilities, there was a general deterioration in hospital care since the early 1970s. The number of hospital beds per capita peaked at 2.6 in 1971 and has gradually dropped since. The National Social Security Institute (INSS), a health care provider, grew slowly but steadily from 1960 to 1980. In 1963, only 4.1 per-



Sources: Census 1971 and ESDENIC-85

FIGURE 4—The trend in Nicaraguan infant mortality: Urban versus rural, 1956–82

TABLE 1—Trends in Nicaraguan Illiteracy Rates, 1950–85

Year	Total[a]	Urban[a]	Rural[a]	Women[b]
1950	62%	30%	80%	61%
1963	49%	21%	70%	50%
1971	42%	18%	66%	43%
1978	39%	17%	63%	38%
1985	25%	13%	40%	26%

[a] Refers to the population ages 10 years and over.

[b] Refers to the population ages 15–44 years.

Sources: 1950 Census,[28] 1963 Census,[29] 1971 Census,[6] EDENIC-78,[12] ESDENIC-85 (unpublished data).

cent of the population were insured. By 1971 coverage of the population had increased to 7.5 percent and by 1978 to 8.4 percent. In 1980 under the Government of National Reconstruction, coverage reached 10.1 percent of the population.

The number of doctors and especially nurses per head of population increased between 1974 to 1985. From 1970–74, there were 5.4 doctors and 2.3 nurses per 10,000 inhabitants. For the period 1975–79 there were 5.8 doctors and 2.6 nurses per 10,000 population and in the five years from 1980–84 there was an average of 6.0 doctors and 3.3 nurses per 10,000 population. The impact of the increased availability of health care professionals (together with dropping numbers of hospital beds per head of population) was reflected in rising per capita rates of hospital discharge and rapidly increasing numbers of outpatient consultations (especially emergency consultations).

Other Public Health Measures—Nicaragua undoubtedly had low rates of access to plentiful clean water supplies and sanitation prior to 1974, but the situation has changed little since then. In 1981, the number of urban domiciliary connections was almost identical to that prior to the earthquake in 1972. Latrine construction by the Ministry of Health, which averaged 4,590 per year from 1974–78, was barely sufficient to keep up with the increase in the rural population.

The use of residual insecticides for the control of malaria decreased steadily in the late 1970s as the World Health Organization campaign for the elimination of malaria lost its momentum. The number of notified cases varied widely from one year to the next but showed no secular downward trend from 1972–82. The average annual reported number of laboratory confirmed cases was 15,386 from 1972–76 and 18,738 from 1977–81. A renewed effort was made to control malaria in 1981 by the administration of mass chemoprophylaxis but the impact was transient.

Discussion

From a variety of sources of infant mortality estimates, this paper has documented a rapid decline in infant mortality in Nicaragua which commenced in about 1974 and was still in progress in 1986. The rate of decline since 1974 is impressive, particularly considering that it occurred at a time when the mortality decline in most countries in Asia, Africa, and Latin America was slowing down.[33] The rate of improvement in life expectancy is similar to that experienced by either Costa Rica (at 0.70/year) and Kerala State (at 0.80/year) during their respective periods of rapid mortality decline, but is not as high as Sri Lanka's (at 1.7/year).[2]

Much work on the determinants of reductions in child mortality has focused upon economic factors. It has often been difficult to separate the role of health and other social interventions from general economic progress, since changes have occurred in parallel. In Nicaragua, this was not the case as the sharp drop in child mortality took place at a time when the

TABLE 2—Average Number of Vaccines Administered per Child under the Age of Five

Years	DPT	Polio	BCG
1970–75	0.59	1.02	0.21
1976–80	0.48	1.24	0.17
1981–85	0.99	2.66	0.33

general living standards of the population, measured in terms of per capita national income, actually decreased.

Although there was some improvement in the nutritional status of Nicaraguan children between 1966 and 1988, this was probably more due to a reduced burden of infectious illness than to increased food intake. The factors which led to a drop in the incidence, severity or duration of infection may be the same as those which brought about lower child mortality. It is difficult to follow breastfeeding practice over the last 20 years but it does seem that exclusive breastfeeding is still far from the norm for a variety of reasons.[34] While health education materials were concerned with promoting breastfeeding, the free milk provided by Ministry of Health programs before and after the insurrection may have encouraged mothers to abandon the practice.

The 1974 turning point in child mortality does not appear to have been brought about by a sudden increase in levels of female literacy, although this factor may have contributed to more recent falls in child mortality. Similarly, most of the reduction in mortality due to diseases preventable by vaccination probably occurred some time in the early 1980s and does not coincide with the onset of the decline in child mortality.

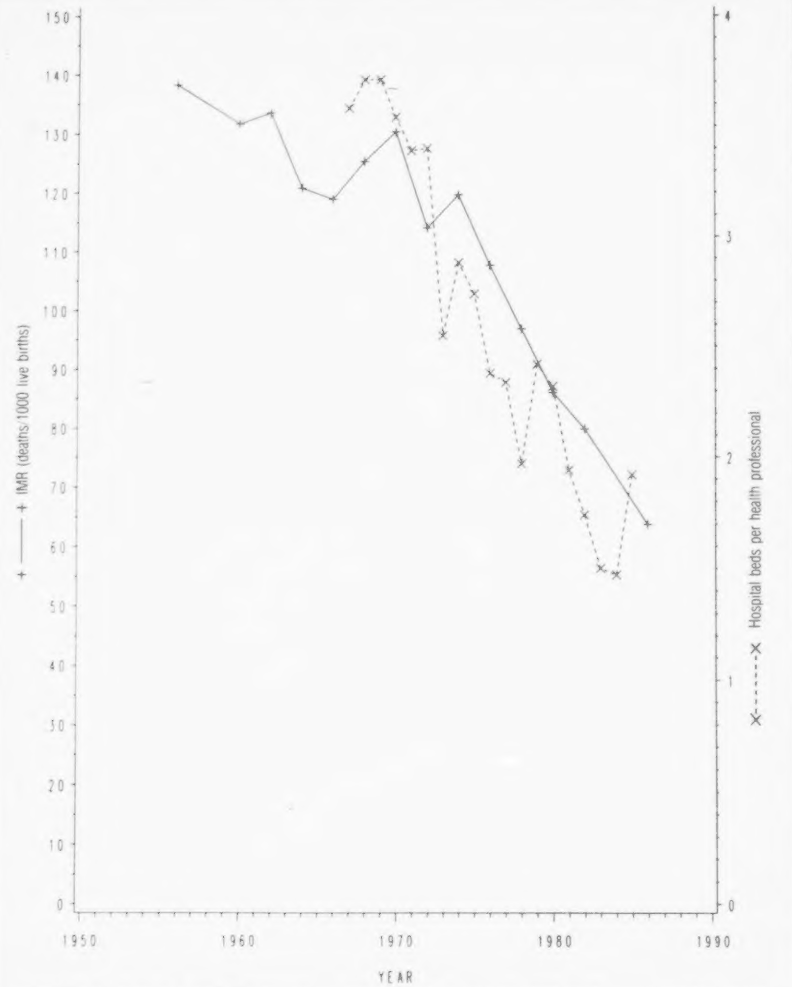


FIGURE 5—Infant mortality trend and the number of hospital beds per health professional in Nicaragua, 1956–86

The solid line is IMR.
The broken line is hospital beds.

The introduction of oral rehydration therapy (ORT) for the management of diarrhea did not occur until the middle of the period of rapidly declining mortality. The Ministry of Health's plan for 1976–80[35] does not even mention ORT, and it was not until 1980 that oral dehydration units were established in health centers and health posts.

The results of this investigation suggest that the availability of water supply and sanitation did not improve significantly from 1974–86. Any improvement in malaria control is unlikely to have been sufficiently great to account for the decline in infant mortality given that malaria is not a major cause of death in this age group in Nicaragua.[36]

The most plausible explanation for the onset in 1974 of Nicaragua's rapid decline in infant mortality can be found in the changes in health services which started to take place at that time. The combined impact of declining per capita numbers of hospitals beds with increasing numbers of health care professionals meant greater availability of personnel to work in the understaffed clinics which had been built in the 1960s. In other words, there was in effect a sharp shift in resources away from hospitals and towards primary and secondary health care. Figure 5 shows how the number of hospital beds per health professional dropped sharply in 1972 and showed a tendency to decrease until at least 1984, parallel to the infant mortality decline.

The reason for this sudden shift in the nature of health care in Nicaragua is complex. The decreasing availability of hospital beds was due to a combination of the devastation resulting from the earthquake, the war, rapid population growth, and economic constraints to public spending. Training of health care professionals, on the other hand, surpassed the increase in population.

Political influences have no doubt also played a part in this situation. The decline and fall of Somoza has been dated from the 1972 earthquake[24,37] and political turmoil has been the norm ever since. A mass popular movement grew up in the late 1970s culminating in the 1979 insurrection. Perhaps sensing that the ground was slipping out from beneath him, Somoza with United States aid began to make significant investment in social programs. In these programs the government tried to target areas with major guerilla activity.[24]

In post-revolutionary Nicaragua, political factors have been equally important. The Sandinista National Liberation Front took power on a program in which health and education were key components.[38] In President Ortega's speech on the 10th anniversary of the Nicaraguan Revolution, reductions in rates of illiteracy and infant mortality were the first items held up as gains of the revolution.[39]

Cultural factors may also have been important. Although tradition changes too slowly to explain a sudden reduction in mortality of the sort experienced by Nicaragua, certain cultural attributes facilitate rapid reductions in mortality. Primary health care programs can have little impact without appropriate patterns of health-seeking behavior. In Nicaragua, there exists what has been described as a pill cuture.[40] People regard orthodox medicine and its providers (i.e. doctors and nurses) with high esteem. Manufactured pharmaceuticals, particularly when given by injection, are generally preferred to traditional herbal remedies although often both will be employed. Nicaraguans readily change treatments when a rapid improvement is not seen and are highly sensitive to the progress of illness in their children. As a result, when health services became more generally available in the 1970s and 1980s, the population quickly made use of them.

It is interesting to compare Nicaragua's period of rapid mortality decline with that of neighboring Costa Rica which also occurred during the early 1970s.[41,42] Both countries had experienced a slow rate of improvement during the 1960s—a phenomenon common to many developing countries.[33] In Costa Rica, the drop in infant mortality was greater in rural areas than in urban areas, both in relative and absolute terms. An analysis of Costa Rica's recent decline in infant mortality also shows up the singular importance of primary health care.[42]

Having reviewed the available data, it is possible to postulate the following scenario. In the late 1960s United States aid was used to pay for the construction of primary health care facilities throughout Nicaragua. In the 1970s, earthquake, war, rapid population growth and economic recession reduced the number of hospital beds per capita. At the same time there was an increase in the supply of nurses and doctors per head of population which made it possible to staff the recently built primary health care facilities. The net effect was an increase in the relative importance of primary and secondary health care vis a vis tertiary health care. The health care facilities provided gained rapid acceptance from the population which already had some cultural affinity for Western medicine.

The social reforms contributing to declining child mortality were made by an isolated and threatened dictatorship in response to the mobilization of impoverished sectors of society. They were continued and extended following the insurrection, as part of the political program of the Sandinista Government which replaced the dictatorship. In early 1990, a new government was elected which is committed to contraction of public expenditure. Monitoring the effects of any change in policy on child health and survival will provide an opportunity to ex-

APPENDIX—Sources of Infant Mortality Statistics in Nicaragua

A review was performed to identify the various sources of data on national child mortality rates in Nicaragua from 1960 to 1989. These are shown in Table A. A note of explanation is necessary about each of the data bases.

The 1971 Census

The last national census of Nicaragua took place on April 20, 1971. Since then, war and lack of funding have prevented the government from carrying out another population census. The 1971 census registered a total population of 1,878,000. The overall rate of omission is thought to be 6.3 percent but in 19 of the 126 municipalities there was an average omission rate of 32 percent and in a further 18 municipalities the rate was 22 percent.[5] An experimental census was carried out in 1969 as a prelude to the 1971 census but its sample was small and unrepresentative of the entire population so the results are not presented here.[43]

The National Demographic Survey of Nicaragua (EDENIC-78)

This was a survey carried out from 1977 to 1978 which included retrospective questions for indirect mortality estimation. It was a follow-up study in which it was intended to compare indirect estimations of mortality with prospective estimates derived from the household change technique. Unfortunately, during the 1979 insurrection all of the prospective data from this survey were lost, leaving only the retrospective questions for mortality estimation. Some of the retrospective data were also lost. The Atlantic Coast Departments of Zelaya and Rio San Juan were excluded from the sampling frame. Although the infant mortality rate in this area is probably higher than in the rest of Nicaragua, it is inhabited by only 8.6 percent of the population.

The Sociodemographic Survey of Nicaragua (ESDENIC-85)

This large household survey took place in 1985, aiming to generate up-to-date demographic and socioeconomic information for the whole country, given that the census planned for 1982 had been suspended. Technical assistance was provided by CELADE and the United Nations Department of Technical Cooperation for Development.[44]

A pilot test in 535 homes was performed in September 1984 and definitive data collection commenced in July 1985. In contrast to EDENIC-78 which excluded the Atlantic Coast, the reference population of ESDENIC-85 covered the entire country. A two-stage cluster sample of 18,000 homes was chosen.

The Sentinel Sites Study

In 1986 the Ministry of Health (MINSA) in collaboration with consultants from UNICEF, established a set of 34 sentinel sites in three regions of the country.[9] These were intended to provide accurate population-based data on morbidity, mortality, and health service utilization for planners and administrators. The sentinel sites were selected by regional teams on the grounds that they be representative of the health conditions of their region. Data were collected by household survey with indirect questions on child mortality.

The National System of Vital Statistics (SINEVI)

In the 1960s, the civil register was administered by the Directorate General of Statistics and Censuses which was part of the Ministry of Economy. In 1970 the DGEC merged with the Department of Economic Studies of the Central Bank to form the Executive Office of Surveys and Censuses (OEDEC). Vital events were registered in the Offices of the Civil Register in each municipality. The data were published annually in the Statistical Yearbook. Coverage was estimated at 70 percent for births and 30 percent for deaths. Only 48 percent of registered deaths were certified by a doctor. The Ministry of Health was responsible for processing cause-specific mortality rates which were not published in Nicaragua but were sent to the World Health Organization.[45]

When the new government took power in 1979, several changes were introduced to improve the registration of vital statistics but, despite these measures, serious deficiencies in death registration remain. In 1987, overall coverage was estimated at 47 percent,[36] but only about 34 percent of infant deaths are reported.[11] Birth registration is somewhat better; in 1983 coverage was calculated to be somewhere between 79.3 and 86.5 percent, varying from less than 60 percent in the rural population to about 95 percent in the urban population.[46]

TABLE A—Sources of Infant Mortality Statistics in Nicaragua

Date	Data Source	Type of Data	No. Women Ages 15–34	Regional Coverage[a] %
1971	National census[6,7]	Population census	256,907	100
1978	EDENIC-78[8]	Sample survey	6,237	91
1985	ESDENIC-85[9]	Sample survey	22,000[b]	100
1986–88	Sentinel sites[10]	Sentinel sites survey	9,615	54
1956–86	SINEVI[11]	Death registration	—	100
1986	SINEVI-86[12]	Birth registration	112,200[b]	100

Source: References 6–12.

[a] The proportion of the inhabitants of the country included in the reference population.

[b] Approximate only.

plore the validity of the explanations advanced in this paper. ☐

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The Role of Attitudes, Beliefs, and Personal Characteristics of Italian Physicians in the Surgical Treatment of Early Breast Cancer

ABSTRACT

The influence of Italian physicians' attitudes, beliefs, and personal characteristics on medical decision making is examined in the case of surgical treatment of early breast cancer. Responses to a mail survey of 657 physicians from different specialties were analyzed comparing doctors recommending a radical procedure (9%) to those preferring a conservative procedure for younger patients only (25%), and those considering conservative surgery the treatment of choice regardless of patients' age (66%). The findings suggest that the likelihood of physicians' preferring a conservative procedure is influenced by their specialty and the extent to which they feel that a patient should have a role in the treatment decision more than by differences in the beliefs of treatment outcomes. Only preferences of the small group indicating radical surgery as the sole admissible treatment can be accounted for by ignorance or distrust of results of recent trials. These findings suggest that other than scientific factors guide many doctors in their decision making; they may help to explain why the diffusion of research results into clinical practice is often disappointingly slow. (*Am J Public Health* 1991; 81:38–42)

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Introduction

The extent to which trial results influence clinical practice is a subject of growing interest and controversy. The roles of doctors' attitudes, belief and personal factors in this respect have seldom been directly assessed, however. The controversy on the optimal surgical treatment of early breast cancer is an excellent area for such an investigation. Despite the substantial body of evidence now available on the comparative efficacy of limited and radical surgery,[1-3] the acceptance of conservative procedures in general practice is slower than one could expect. Possible explanations offered include: ignorance of trial results; uncertainty in interpreting trial results[4-9]; the influence of personal or institutional-related factors.[10-12]

To shed light on the merits of these three related hypotheses, we undertook this study as part of a current research program aimed at assessing quality of care for breast cancer patients in general hospitals.[13]

Organization of Cancer Care in Italy

In Italy health care is provided largely free of charge with patients co-payment for a limited—though increasing—number of services. The national health service—launched in 1978—envisages a system where health care is provided through public facilities (approximately 1,000 general hospitals where about 40,000 doctors practice) or, indirectly, by contracting with private health providers. Relative to cancer care apart from patients seen at the few Italian cancer centers, most patients are cared for at public general hospitals. There is a great deal of variability in the type of existing organization within these hospitals: few are equipped with oncology departments staffed with board-certified oncologists; others—accounting for approximately 10 percent of the total—see patients in oncologic wards staffed by internists, surgeons, and radiotherapists with special interest in oncology; but the vast majority of hospitals have no ad hoc organization and patients are seen at different departments depending on their specific needs.

Methods

This study was conducted between October 1986–June 1987 on a sample of hospital-based physicians. Sixty hospitals taking part in an existing monitoring program on quality of cancer care were invited to participate, 65 percent agreed to do so. Participating and non-participating hospitals were similar in size (median number of beds of 888 and 870, respectively), and organization of cancer care (35 percent of both groups had radiotherapy on site and an oncology department was present in 20 percent and 30 percent of participating and non-participating cen-

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TABLE 1—Distribution of Physicians' Sociodemographic and Practice-related Characteristics according to Therapeutic Preferences

	R N = 33 (9%)		C-R N = 112 (25%)		C N = 298 (66%)	
Demographics	n	(%)	n	(%)	n	(%)
Age (years)						
≤35	9	(27)	37	(33)	120	(40)
36–50	18	(55)	56	(50)	139	(47)
>50	6	(18)	19	(17)	39	(13)
Sex						
Male	29	(88)	104	(93)	260	(87)
Female	4	(12)	8	(7)	38	(13)
Hospital Size (beds)						
≤400	4	(12)	23	(20)	65	(22)
401–1000	15	(46)	50	(45)	113	(38)
>1000	14	(42)	39	(35)	120	(40)
Patient Volume**						
<20	9	(28)	30	(27)	68	(23)
20–50	13	(41)	48	(44)	106	(36)
>50	10	(31)	32	(29)	118	(41)
Availability In-house Radiotherapy Equipment						
No	14	(42)	44	(39)	106	(36)
Yes	19	(58)	68	(61)	192	(64)
Specialty* (p = 0.0003)						
Internal medicine	6	(9)	22	(31)	42	(60)
Surgery	23	(11)	61	(29)	127	(60)
Radiotherapy	2	(3)	3	(5)	54	(92)
Medical oncology	1	(2)	12	(21)	43	(77)
Gynecology	1	(2)	12	(27)	31	(71)

R = radical surgery regardless of patient's age;
C-R = conservative only in younger patients;
C = conservative surgery regardless of patient's age.
*Information not available in three cases.
**Information not available in nine cases.

ters, respectively). Six hundred and fifty-seven questionnaires were returned corresponding to an overall response rate of 68 percent (657/970), 20 percent of which were from physicians not seeing patients with breast cancer. Surgeons had a 60 percent response; internists 68 percent, gynecologists 74 percent, radiotherapists 84 percent and oncologists 89 percent. Participation tended to be slightly higher among younger (78 percent) and female (77 percent) physicians. An additional telephone inquiry was attempted on a randomly selected one-third of the 313 nonresponders. All were successfully traced and their responses were similar to those obtained by mail.

In the questionnaire, basic data were requested about the hospital in which physicians practiced and some personal characteristics. The first section of the questionnaire described four scenarios, two dealing with treatment of primary breast lesion and two dealing with adjuvant post-surgical treatment. In this paper we shall discuss the results relative to the surgical preferences. The first scenario was phrased as follows:

> A 35-year old premenopausal patient presents with a 1.5 cm. diameter mass in the upper outer quadrant of her right breast. Axillary lymph nodes are clinically negative and there are no other signs of metastases. Assuming that whatever blood test, X-ray examinations, and nuclear scans you use are negative and that a preliminary biopsy has established the diagnosis of carcinoma, do you favor a radical surgical approach or a breast-sparing operation (limited surgery) combined with primary radiotherapy? The radical surgical approach would mean a type of radical mastectomy (i.e. Halsted or Patey), while the limited surgery would involve a quadrantectomy, plus axillary dissection and radical radiotherapy.

After checking one of the two options (1 = I favor a radical surgery approach; 2 = I favor a limited surgery approach), responders rated the superiority of the alternative treatment modes in achieving the following outcomes: local control, disease-free survival, avoidance of morbidity, good cosmetic results, and long-term survival. A 5-point scale was used for each outcome: 1 = limited surgery plus irradiation is vastly superior to radical surgery; 5 = radical surgery is vastly superior to limited surgery plus irradiation; 3 = the two treatment modes are equally effective.

A second case presentation referred to an older patient (i.e. 60 years) with identical clinical information to see whether doctors deemed patient age a critical factor in treatment indication. The same treatment choices and efficacy judgment were required.

In the second section, physicians were asked to comment on findings from a pattern of care study conducted in Italy in 1984 documenting that only approximately one out of four patients eligible for limited surgery actually had limited surgery.[6] Doctors were asked to report why in their opinion a radical procedure was still the preferred treatment option by choosing among a list of possible explanations reported into the questionnaire. A free text format was also included so that they could add other reasons if they were not satisfied by the list.

The final section of the questionnaire contained a series of statements designed to measure physicians' attitudes toward involving patients in treatment decisions. Responders indicated on 5-point scales the extent to which they agreed or disagreed with 10 phrases such as "asking patients to participate in treatment decisions produces unnecessary stress for them," or "patients who participate in treatment decisions are less anxious and depressed during recovery." Statements were worded so that, for some, agreement indicated attitudes favoring participation and, for others, an unfavorable attitude. The scale was similar to the one used in a previous study in the United States.[10]

Analysis of the role of physicians' willingness to involve patients in treatment decisions was done both by considering answers to individual statements and by analyzing the overall score based on the scale; the Kruskal-Wallis test was used for statistical analysis.[13] In the computation of this test, all of the scores from all samples combined are ranked. The sum of the ranks in each sample is found, and the test determines whether these sums of ranks are so disparate that they are not likely to have come from samples which were all drawn from the same population.[13] Results of this type of analysis are those reported in Table 2.

Results

Table 1 shows the distribution of physicians' sociodemographic and practice-related characteristics according to therapeutic preferences. Two-thirds felt that a conservative procedure was the appropriate treatment independently of patients' age; only 33 (9 percent) preferred the traditional radical procedure regardless of age. Almost all the radiotherapists favored the conservative procedure regardless of patients' age while more than one-fourth of doctors from other specialties deemed the conservative procedure appropriate only for younger patients. Surgeons and internists were more often supportive of the traditional radical technique.

A greater willingness to involve patients in the decision-making process was associated with preference for conservative surgery (Kruskal-Wallis test = p = 0.011 for difference in overall patient participation score among the three groups). Detailed analysis of physicians' answers to individual statements component of the overall score indicated that doctors recommending conservative surgery regardless of patient age (the "C" group in the tables) had a consistently different pattern of attitudes (see Table 2) compared to those indicating radical surgery as the optimal treatment.

Besides this marked difference in personal attitudes, the groups also dif[illegible] in their perceptions of the efficacy and overall desirability of the two treatments (Table 3). Almost all doctors in favor of the more radical procedure (94 percent) thought it was superior in terms of local control, particularly for the older woman while doctors always favoring limited surgery most of time claimed comparable effectiveness of the two treatments in all but cosmetic results.

In the intermediate group (i.e. those preferring conservative surgery in the younger but radical in the older patient) the relationship between reported therapeutic preference on one side, and attitudes and beliefs about outcomes on the other, was less easy to interpret. Patients' age seemed, although to a limited extent, to influence perception of treatment effectiveness in this group. Physicians' answers were more like those of the radical

TABLE 2—Distribution of Scores (mean ranks) in Individual Statements Exploring Physicians' Willingness to Involve Patients in Treatment Decisions according to Therapeutic Preferences

Negatively worded statements	R	C-R	C	p value
	Mean Ranks			
Patients may lose confidence in their physician if they believe that he/she has no firm opinion about the best treatment	221.1	227.9	219.8	.80
Encouraging patients to participate may do more harm than good	197.6	210.5	229.0	.15
Patients can't possibly make good decisions because they don't understand information	215.1	200.2	230.9	.05
Asking patients to participate in treatment decisions produces unnecessary stress	198.3	194.6	234.9	.003
Even if they receive enough information most patients are too upset to make a decision	216.8	197.5	231.8	.03
Positively worded statements	**R**	**C-R**	**C**	**p value**
Patients who participate in treatment decisions make a better adjustment to the disease	225.1	253.6	209.8	.003
Patients should have a greater influence on treatment decisions than their doctor	243.2	241.8	212.2	.05
Patients who participate in treatment decisions are less anxious and depressed	245.3	244.4	210.9	.02
If given comprehensible medical information pts. can make good decisions about treatment	248.9	249.4	208.6	.004
Most patients want to be involved in treatment decisions	217.8	249.2	212.2	.02

R = radical surgery regardless of patient's age;
C-R = conservative only in younger patients;
C = conservative surgery regardless of patient's age.
Significance tests use Kruskall-Wallis One-Way Analysis of Variance.[13] See text for further information.

TABLE 3—Proportions of Doctors with Different Beliefs about the Yield of Radical and Conservative Surgery according to Specific Treatment Outcomes

		Therapeutic preferences					
		R		C-R		C	
Type of Treatment Outcome	Perceived efficacy	35y old	60y old	35y old	60y old	35y old	60y old
Prevention of local recurrence	C>R	6	3	10	10	8	7
	C=R	9	3	62	42	77	76
	R>C	84	94	28	48	15	17
Disease-free interval	C>R	—	—	4	4	4	4
	C=R	18	9	83	63	93	93
	R>C	82	91	13	33	3	3
Risk of morbidity	C>R	6	6	28	21	24	25
	C=R	24	24	55	49	59	59
	R>C	70	70	17	30	17	16
Cosmetic results	C>R	94	76	95	84	96	94
	C=R	3	19	3	13	2	4
	R>C	3	5	2	3	2	2
Long-term survival	C>R	3	3	6	4	4	4
	C=R	24	12	82	63	94	93
	R>C	73	85	12	33	2	2

R = radical surgery regardless of patient's age;
C-R = conservative only in younger patients;
C = conservative surgery regardless of patient's age.

Legend:
C>R = Doctors considering conservative surgery superior to radical;
C=R = Doctors that attribute the same effectiveness to the two treatments;
R>C = Doctors considering radical surgery superior to conservative.

TABLE 4—Physicians' Explanations of the Limited Popularity and Preference for Execution of Conservative Surgery in Younger Patients Documented in a Nationwide Pattern of Care Study in 1984 (Italy) (see ref. 6)

	R		C-R		C	
	n	(%)	n	(%)	n	(%)
Trial results still controversial	14	(42)	53	(47)	53	(18)
Technical difficulty of cons. surgery recommends its performance mostly in younger patients	7	(21)	20	(18)	21	(7)
Cons. surg. is limited by the availability of radiotherapy equipment	10	(30)	40	(36)	122	(41)
Surgeons are still reluctant to accept trial results	2	(6)	11	(10)	101	(34)
Cosmesis not yet sufficiently considered	2	(6)	7	(6)	25	(8)
Others	2	(6)	7	(6)	26	(9)

R = radical surgery regardless of patient's age;
C-R = conservative only in younger patients;
C = conservative surgery regardless of patient's age.
Column percentages exceed 100 because doctors could give more than one answer.
x^2_{10} d.f. = 25.6 $p < 0.03$

group particularly with respect to the decision pattern for the older patient (Table 3).

As a whole, joint examination of the beliefs of the intermediate group (Table 3) and their willingness to involve patients in treatment decisions (Table 2) suggests that—independently of perceived treatment effectiveness—less consideration for patients' expectations was probably the factor influencing choice of a radical procedure for an older patient in whom negative cosmetic consequences were judged less important. This interpretation is supported indirectly considering the distribution of physicians' opinions of reasons why the diffusion of conservative surgery is still limited (Table 4). The majority in the radical group (42 percent) claimed conflicting trial results as the reason for this, but 34 percent of doctors in the conservative group felt that prevailing practice could be accounted for by surgeons' reluctance to accept trial results (Table 4).

Discussion

Decisions about alternative treatments involve implicit and explicit weighing of trade-offs among different outcomes (survival, morbidity, functional status, etc.). Our study suggests that beliefs about treatment outcomes derived from clinical trials are not always the most important factors in decisions for some doctors. This is not a new finding as other studies exploring determinants of physicians' practice[10–14] have found associations of specialty, age, and practice-related characteristics with practice patterns.

The grouping of doctors according to their therapeutic preferences is of particular interest for analyzing the consistency between perceived outcomes of treatment and the decision pattern. At one extreme, we found a small group (9 percent) whose therapeutic preference—although based on a miscomprehension, or non-acceptance, of recent scientific literature—was consistent with perceived outcomes of treatment: doctors chose a radical procedure because they thought it was more effective than limited surgery. If we take their answers as a true reflection of their opinions, and not as the result of a preference-dependent selection of that segment of the literature fitting their own preconceptions, exposure to the relevant scientific literature would be the appropriate remedial action.

At the other extreme, those choosing limited surgery appeared to be guided by the consideration that if this approach is just as effective as a radical procedure, the less mutilating treatment should be preferred.

Although the beliefs of the "intermediate" (i.e. radical-conservative) group about treatment effectiveness were similar to those of the "conservative group," radical surgery was still their preferred treatment for a 60 year old patient. While we cannot rule out that this was due to some anticipated contraindication for limited surgery in the older patient, their lack of consideration for the patient's right to share in the decision-making appears a more convincing explanation of their different behavior. When facing the same scientific uncertainty less "paternalistic" doctors (i.e. those attaching greater importance to patients' opinions) appear to be influenced by patient-centered outcomes (i.e. cosmetic) more than those who think they know what is in their patients best interest, thus relying more on physician-centered end-points (i.e. disease free-survival, total survival).

The original sample was drawn from among physicians working at a group of general hospitals participating in a program of quality of care evaluation.[6] Even if for some reason participating hospitals were not fully representative of all Italian physicians, this does not affect the internal validity of our findings. Furthermore, our findings favorably compare with other surveys on specialists[14] and non-specialists[10,17,18] in different countries. Studies from the UK,[18] USA,[10] and Canada[14] all consistently showed that surgeons, and to a limited extent also internists not specialized in oncology, are still more often in favor of radical procedures.

Data on actual practice would be stronger evidence of treatment preferences, but they are seldom available. Given that our study was done in a group of hospitals where a monitoring program on care given to breast cancer patients was going on,[6] it may be interesting to look at some comparisons between the two sources of information. Consistent with the key role of surgeons' opinions in the decision about surgery, we found—within a group of more than 1,000 cases of newly diagnosed patients in 1984–85[6]—that limited surgery was offered only to 25 percent of eligible patients. Also, data on actual practice confirmed the age-dependent orientation of doctors in that the more conservative operation was given to 34 percent of women younger than 50 years and compared to 21 percent among older patients.[6]

The public health implications of our study depend on the path of therapeutic decisions, which in turn depend on health care organization in different countries. In Italy, where cancer care is still seldom interdisciplinary, especially in community hospitals, it is worrisome that as many as 40 percent of surgeons—i.e. the specialists who decide about surgery—still favor radical surgery for an older patient and 11 percent even for a younger patient. This should not be seen as totally surprising since at the time this survey was carried out official recommendations of the Italian Breast Cancer Task Force were still in a transition period. They left open the choice of the most appropriate treatment indicating as acceptable both limited surgery and a more radical procedure (i.e. the Patey type of "modified" radical mastectomy).

Where cancer care is multidisciplinary (like in the US or Canada), it is likely that the more modern opinion held by other specialists is already forcing surgeons to change opinion and consequently practice. Less easy to predict is the extent to which changes in doctors' perception of patients' rights in treatment decision will affect prevailing practice in the near future. Considerations of this sort should be kept in mind when comparing results of patterns of care studies and physicians' surveys. ☐

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Maternal Feeding Behavior and Child Acceptance of Food during Diarrhea, Convalescence, and Health in the Central Sierra of Peru

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ABSTRACT

Feeding patterns by mothers and child acceptance of food were measured in a Peruvian village to determine changes on days when children had diarrhea as compared to days of convalescence and health. Morbidity surveillance identified 40 children, aged 4–36 months, with diarrhea. Children were followed using twelve-hour in-home structured observations during two to four days each of diarrhea, convalescence, and health. Using scales of maternal encouragement to eat and child acceptance of food and cumulative logistic regression analyses, maternal encouragement to eat decreased significantly during convalescence compared to diarrheal days (OR: 0.54, 90% CI: 0.35, 0.82) and health compared to diarrhea (OR: 0.65, 90% CI: 0.46, 0.93). In contrast, child acceptance of food increased during health compared to diarrhea (OR: 1.55, 90% CI: 1.02, 2.35). Results illustrate the importance of carefully examining the behavioral aspects of nutritional intake. Decreases in intake during diarrhea are due to anorexia and not withdrawal of food by mothers. In response to reductions in child appetite during illness, mothers are more likely to encourage children to eat, while they tend to become more passive feeders after the diarrhea has stopped. Program efforts should focus on messages to feed children more actively especially after diarrhea episodes, when appetite levels increase. (*Am J Public Health* 1991; 81:43–47)

Introduction

Worldwide studies of infant and child nutrition have demonstrated that poor infant feeding and weaning practices along with frequent infections, in particular diarrheal diseases, are important determinants of growth faltering and malnutrition in the developing world.[1–3] However, the primary focus of diarrheal disease control (CDD) programs has been on improved case management through the promotion of oral rehydration therapy, while dietary management has been relatively neglected. Where program messages do exist, they are generally quite vague—such as "continue feeding during diarrhea"—and therefore may be difficult for mothers and other caretakers to implement.[4]

The development of specific recommendations for feeding practices requires information about existing infant feeding practices during illness. In the absence of data, the public health community has often assumed that mothers in nearly all cultures withhold food from their children during diarrhea episodes.[5–8] This implies that modification of this ill-advised presumed behavior will reduce the negative nutritional effects of diarrhea. Such a perspective ignores the possibility that mothers may already be feeding their children during diarrhea, and that diarrhea-associated anorexia may be the major determinant of reduced dietary intakes.[9–10]

This study focused on the behavioral factors related to feeding during diarrhea, and assessed the relationship of illness to appetite in young children. In particular, we quantified the degree of effort caretakers applied to encourage children to eat and the acceptance of food by children during diarrhea episodes, the immediate postconvalescent period, and subsequent, symptom-free days of "health."

Methods

Data Collection

The study was conducted in a rural Andean village in the Callejon de Huaylas, Peru as part of the Dietary Management of Diarrhea program, funded by the United States Agency for International Development, Office of Nutrition. It was implemented in Peru by the Institute of Nutrition Research and the Federal and State Ministries of Health in collaboration with Johns Hopkins University. The project has been described in greater detail elsewhere.[11–12]

Morbidity surveillance in the study area identified children with diarrhea by visiting each household at 48-hour intervals. A total of 118 children, between the ages of 4–36 months, were under surveillance for 12 months. Diarrhea was defined as four or more liquid or semi-liquid stools/day, convalescence as 0–1 liquid or semi-liquid stools/day immediately after at least two days of diarrhea, and healthy observation days as an absence of any illness symptoms. This latter requirement was quite problematic, since children in this setting were frequently ill with some sort of infection.

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TABLE 1—Mean Energy (Kcal/kg/day) and Protein (g/kg/day) Intake by Stage of Illness among Breastfed Children 4–36 Months of Age

	Stage of Illness		
Intake	Diarrhea	Convalescence	Symptom-Free
	n = 36	n = 36	n = 36
Kcal/kg/day	76*	85	86*
g/kg/day	1.3†	1.5	1.6

*Difference = 10 kcal/kg/day (p = 0.052)
†Difference = 0.3 g prot/kg/day (p = 0.009)
SOURCE: Esrey *et al*, FASEB 1988

Twelve-hour in-home structured observations of maternal and child feeding behavior were completed, during two to four days each of diarrhea, convalescence, and health. Forty children (drawn from the population under surveillance) were studied for the present study. Children were eligible for this study if, on the day of morbidity surveillance they met the criteria for diarrhea, if the episode was no more than one or two days old, if the children were not exclusively breastfed, and if a data collector was available to begin a set of 12-hour observations. Children were selected for across a full calendar year.

Weighed dietary intakes of the same children, reported in detail elsewhere,[13] demonstrate that there is a decrease in dietary intakes during diarrhea (Table 1). What remains to be explained is why these reductions occur.

A data sheet was developed to code observations of maternal feeding behaviors and child acceptance of food during each meal. A total of 787 meals were recorded for the 40 children. For 75 percent of the meals, mothers were the feeders, so we refer to "maternal feeding behavior" in our discussion. Neither the identity of the caretaker nor that of the observer was found to be significantly associated with either the mother's or child's behavior (data available from authors on request).

Behavioral observations were made at the level of the food or drink, for a total of 951 observations. Feeding observations of commercial oral rehydration solution (ORS) and non-caloric teas have been excluded. If a child consumed potatoes and soup during the same meal, the data collector would code child acceptance of food behaviors separately for each food. This was done because field testing showed that behaviors varied within a single meal episode, depending on the food offered. In addition, we wanted to assess whether children preferred or rejected specific types of food, either during illness, recovery, or health.

Data collectors were aware only that the purpose of the research was to measure diet and feeding behavior during illness, along with other household treatment behaviors. To check whether the invasive nature of the study methodology (that placed data collectors in homes for repeated 12-hour observations) may have influenced maternal feeding behavior, a series of three-hour feeding observations without weighing either food or children before and after breastfeeding were completed for 30 children. There were no significant differences in the frequency or duration of breastfeeding between the three-hour and 12-hour observations (data available from author on request).

Scale Construction

The data sheet contained five items measuring maternal feeding behavior and four items measuring child acceptance of food. Because these items had a logical order (i.e. mothers would not physically force children to eat if they had not already encouraged and pressured them verbally to eat), Guttman scaling techniques were used for scale construction.[14–15] The coefficients of reproducibility were quite high, .98 for Maternal Encouragement to Eat and .97 for Child Acceptance of Food, indicating that the observed response patterns fit closely the response patterns predicted by the Guttman analysis. After testing, three items remained in each scale.

For the Maternal Feeding Behavior scale the final items were: 'Verbally Encourage'→ 'Verbally Pressure'→ 'Physically force.' For the Child Acceptance of Food scale the items were: 'Rejects Food'→ 'Appetite Level'→ 'Asks for Food.' These two scales were then used as the dependent variables in the statistical analyses.

The Child Acceptance of Food scale was validated against actual intakes by comparing the mean scale for the day to the number of kilocalories from non-breastmilk for the day. Because the scale is ordinal rather than interval, Spearman's rho formula was used to calculate the correlation. The final Spearman correlation coefficient was .47, which shows a strong relationship between the scale and actual intakes.

There is no obvious means of validating the Maternal Encouragement to Eat scale against actual intakes. Increased encouragement to eat is a response to decreased appetite. The lower the appetite, the more encouragement children receive. Since maternal encouragement may or may not be successful, it is not clear that actual intakes should be associated with encouragement.

Cumulative Logistic Regression

To preserve the ordered categorical nature of the scales, cumulative logit procedures were used[16] and separate logistic regressions were performed for each cut-point (i.e. each ascending value on the scale). Because our early models indicated that the magnitude and direction of the beta estimates for various factors were not consistent across these cut-points, we were not able to make an assumption of "proportional odds," which would have allowed us to report only one set of final beta estimates. For the Maternal Feeding Behavior scale, only two cut-points were used because just 13 observations scored 3, which was too small a percentage of observations to compare with the 0–2 category.

The main hypothesis was that "stage of illness" affects both maternal and child feeding behavior, so this variable was entered into the model first. Then, because we knew that age should theoretically influence feeding behavior, we added age to the model as a categorical variable. The study design followed children prospectively through diarrhea, convalescence, and health, as they were aging. Children 4–5 months old were omitted from these analyses because they were few in number and inconsistent in preliminary analyses. Even with age in the model, "stage of illness" was significantly associated with feeding behavior and child acceptance of food.

Two different techniques were used to test for possible confounding factors, one following Kleinbaum, *et al*,[17] and one following Greenland.[18] Both were modified to allow the examination of polychotomous dependent and independent variables. On the Maternal Feeding Behavior

TABLE 2—Final Logistic Regression Model, Mother's Encouragement to Eat Score (1st Maternal Feeding Behavior Scale Cut-Point: 0 vs 1–3)

	Odds Ratio	90% Confidence Interval
Intercept	0.66	(0.36, 1.24)
Stage of illness		
Ref: Diarrhea	1.00	—
Convalescence	0.54	(0.35, 0.82)
Health	0.65	(0.46, 0.93)
Age (months)		
6–11	0.82	(0.35, 1.93)
12–17	1.65	(0.70, 3.88)
Ref: 18–36	1.00	—
Consistency		
Ref: Liquids/semi-solids	1.00	—
Solids	0.39	(0.30, 0.51)
Breast milk consumed (kcal) during 12-hour observation		
Ref: None	1.00	—
≤410	1.82	(0.87, 3.80)
>410	1.63	(0.69. 3.84)

TABLE 3—Final Logistic Regression Model, Child's Acceptance of Food Score (2nd Child Food Acceptance Scale Cut-Point: 0,1 vs 2,3)

	Odds Ratio	90% Confidence Interval
Intercept	1.50	(0.81, 2.76)
Stage of illness		
Ref: Diarrhea	1.00	—
Convalescence	1.12	(0.77, 1.64)
Health	1.55	(1.02, 2.35)
Age (months)		
6–11	1.49	(0.92, 2.40)
12–17	0.90	(0.55, 1.48)
Ref: 18–36	1.00	—
Breast milk consumed (kcal) during 12-hour observation		
Ref: None	1.00	—
≤410	0.48	(0.31, 0.74)
>410	0.28	(0.15, 0.49)
Consistency		
Ref: Liquids/semi-solids	1.00	—
Solids	0.62	(0.47, 0.82)
Kilocalories consumed at the last feeding, either breastmilk or solid food		
Ref: 0–33.4	1.00	
33.4< <64	0.58	(0.43, 0.77)
≥64	3.32	(2.42, 4.56)

scale, variables were retained in the model if they were found to be confounders at either cut-point, while on the Child Acceptance of Food scale, variables were retained if they were found to be confounders at two of the three cut-points. Variables tested include, among others, type and consistency of food, caloric density of the food, kilocalories eaten at last meal, time since last meal, amount of breastmilk consumed during the observation period, the number of breastfeeding episodes, time of day, number of meals during the day, sex of child, identity of caretaker, and number of foods at a meal.

The variable fever (measured with a fever strip and later dichotomized) was deleted from the final analyses because, although highly significant in the preliminary analysis, the number of observations when fever was present (n = 17) was too small for multivariate analyses. However, a simple odds ratio of fever with appetite scores at cut-point 2 (corrected for intra-child correlation) shows that fever is much more likely to be associated with lower appetite (odds ratio = 0.06, 90% confidence interval: 0.01 to 0.46).

The final models were developed by adding to the model of stage of illness and age those variables that proved to be confounders. In addition, food consistency was added to both models since it was found to be closely related to both child appetite and maternal encouragement. Final variance estimates were corrected for the presence of intra-child correlation due to the longitudinal nature of the study design.[19]

Results

In the interest of brevity, the final models presented are those with cut-points closest to the median for both scales (Tables 2 and 3). However, when results for other cut-points differ significantly for the variables of primary interest, these are discussed.

For the Maternal Feeding Behavior scale (Table 2), when controlling for age and the other factors shown, the scores were significantly lower during convalescence and health compared to diarrhea (for the second cut-point, i.e., 0–1 vs 2–3, scores were not significantly lower for convalescence). In other words, mothers were more likely to encourage their children to eat during diarrhea episodes, compared to the other two intervals. In addition, mothers gave more encouragement when their children were eating liquid or semi-solid foods.

For the Child Acceptance of Food model (Table 3), when controlling for age and the other factors shown, children had lower food acceptance scores during diarrhea compared to health. For this cut-point, food acceptance scores were not significantly higher during convalescence, compared to diarrhea, but they were significantly higher in the model for the third cut-point (i.e., 02 vs 3).

Acceptance of food scores were higher when children were presented liquid or semi-liquid foods, compared to solids, regardless of stage of health. Twelve-hour breast milk intake was negatively associated with appetite on the child scale, indicating that higher levels of breast milk intake reduced appetite for non-breast milk foods. Breast milk consumption was measured by weighing the children immediately before and after breastfeeding.

Interestingly, in the preliminary screening, Kcals from breast milk consumed between meals was not signifi-

TABLE 4—Cross-Tabulation of Maternal Encouragement to Eat Scale and Child Acceptance of Food Scale

Maternal Scale (Low to High)	Count Row% Col%	Child Scale (Low to High) 0	1	2	3	
	0	12	191	254	79	536
		2.2	35.6	47.4	14.7	
		27.9	63.5	67.6	70.5	
	1	13	91	112	31	247
		5.3	36.8	45.3	12.6	
		30.2	30.2	29.8	27.7	
	2	18	19	10	2	49
		36.7	38.8	20.4	4.1	
		41.9	6.3	2.7	1.8	
		43	301	376	112	832

Goodman and Kruskal's Gamma = −.23851

cantly associated with the child's food acceptance at the subsequent meal, although the coefficients for this factor were negative, as was the case for 12-hour breast milk intake. We interpret this to mean that breastfeeding is associated with an overall reduction of child appetite for other foods, which cannot be adequately assessed at a meal level. This relationship did not appear to be confounded by time, as time since last breastfeeding was not found to be significantly associated with child's food acceptance.

Another function included in the screening, namely Kcal from either breast milk or non-breast milk consumed during the last feeding episode, was positively associated with child appetite at the current meal when comparing a high level of consumption (≥64 Kcal) to a low level (≤33.4 Kcal). However, the relationship was negatively associated when comparing an intermediate level (between 33.4 and 64 Kcal) to a low level. This same inconsistency was observed for the first cut-point, but for the third cut-point, both the intermediate and high levels were positively associated with child appetite. Because the positive association is consistent with the preliminary analyses, we expect that this is the correct direction.

A cross-tabulation of the scores on the Maternal Encouragement to Eat Scale and those on the Child Acceptance of Food Scale (Table 4) shows a clear negative relationship between the two scales, suggesting that mothers were increasing their efforts to feed their child as the child's appetite decreased. This relationship would have appeared stronger if the effect of food type was removed from both scales because the logistic analysis showed that both child acceptance and maternal encouragement increased when liquid and semi-solid foods were involved. The table also shows that these mothers were generally passive feeders, 64 percent of the time giving no encouragement to eat. These data corroborate the same finding in our early ethnographic work on this population. However, at the lowest level of child acceptance of food, over 70 percent of the time, mothers gave some encouragement.

Discussion

The results from this study demonstrate that these Peruvian mothers, normally quite passive child feeders, were more likely to encourage their children to eat during diarrhea episodes compared to both convalescence and health. Children experiencing diarrhea did appear to have observable reductions in appetite, and more often rejected food. These results corroborate our ethnographic data. Mothers frequently voiced concern that their children were "weak" and had reduced appetites during diarrhea.[11]

The more total kilocalories consumed by the child during the previous meal or breastfeeding, the better the appetite at the current meal. At first, this seemed counter-intuitive, but Esrey, *et al*,[13] found that these children averaged only 71 percent to 91 percent of recommended energy intakes, so if the children were not suffering from diarrhea or fever-induced anorexia, they would probably be willing to eat whenever food was offered. If this was the case, a child's appetite at any given meal would reflect the general level of health for the day rather than the amount consumed at the previous meal/breastfeeding, which was borne out by the positive relationship between appetite at the current meal and kilocalories consumed at the previous meal/breastfeeding. Again, this relationship did not seem to be confounded by time since last meal/breastfeeding, which was tested and was not significant.

What is the public health significance of these data? First, it is clear that in this setting mothers are not withholding food from their children when they experience diarrhea. Where this issue has been closely studied in other sites, similar results have been found. For example, in Nigeria, where we have used the same methodology as in this Peruvian site, mothers appear to force-feed their children more often when they have diarrhea, possibly as a response to their children's refusal to eat.[20] In India, some mothers shift the diet during diarrhea toward foods that they perceive as "helpful" and away from foods perceived as "harmful."[21] In each of these three sites, mothers' concern about appetite loss during diarrhea was high.[11,20-22] We hope that these data will replace the anecdotal information and survey data that reports that mothers "starve" their children during diarrhea episodes.

The role of anorexia during diarrhea appears to be an important factor in reductions of dietary intake during illness. We are not aware of other studies that have attempted to measure the degree of appetite of children in a field setting, although one clinic-based study suggested that anorexia was an important mechanism for reduced dietary intake during diarrhea.[23] Although it is expected that children's appetites should rise during the convalescent phase, in the present study this was observed only when logistic regressions were done that split children with high appetites into a separate group. In this case, child acceptance of food did rise during convalescence, suggesting that program messages should communicate to mothers the need to feed their children more during the recovery period. The data here show that mothers discontinued their more active encouragement to eat when diarrhea stopped, thereby missing an opportunity for their children to consume important "catch-up" nutrients. Program messages, therefore, should focus on a child's increase in appetite during the convalescent period, and encourage mothers to actively feed their children both during *and* after diarrhea. In addition, specific recommendations on foods appropriate during diarrhea and convalescence could be made and less emphasis placed on vague feeding messages. These messages should be based on cultural beliefs regarding appropriate foods to offer during diarrhea.[12]

We have shown a clear link between the presence of fever and the rejection of food by children. The effect of fever on appetite is worrisome because of the number of infections where fever is commonly present, such as upper respiratory infections and malaria. Lopez de Romaña, *et al*,[24] found fever present in children during 13.7 percent of all illness days, and Brown, *et al*,[25] reported an approximate 30 percent reduction in dietary intake among weanlings whose mothers reported the presence of fever, although Martorell, *et al*,[26] found no link between fever and growth rates. Clearly, more work is required to investigate the effect of fever on dietary intake and growth, and whether the administration of acetaminophen improves the acceptance of food by ill children (Gove, personal communication).

In conclusion, this study illustrates the importance of examining the behavioral aspects of nutritional intake. Simply measuring changes in caloric intake does not provide an explanation as to why the changes have occurred, so interventions may be based on faulty assumptions of behavior. In this case, mothers do not, as commonly assumed, withhold food from children with diarrhea. On the contrary, they actually increase their efforts to feed their children, as a response to the child's decreased acceptance of food. ☐

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The Epidemiology of Licit and Illicit Substance Use among High School Students in Greece

ABSTRACT

Findings on self-reported adolescent licit and illicit substance use are presented based on a nationwide 1984 probability sample of 11,058 Greek adolescent students ages 14–18 years old. Regular smoking and use of alcohol in the 30 days prior to the survey were reported by 22.3 percent and 82.8 percent, respectively. Nearly one-third of the students (30.3 percent) reported lifetime use of psychotropic drugs without prescription, without ever having used any illicit drug. Illicit drug use is less common in Greece than in other European and North American countries with a lifetime prevalence rate of 6 percent. Regular use of tobacco, alcohol, and illicit drugs was more common in males, while unprescribed use of licit psychotropic drugs prevailed in females. Regular smoking, drinking, and illicit drug use were associated with urbanization but not socioeconomic status. Between 1984 and 1988 in an Athenian subsample of schools there was a 20 percent increase in illicit drug use among males. Use of psychotropic drugs without prescription decreased much more than use of tobacco and alcohol. *(Am J Public Health* 1991; 81:48–52)

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Introduction

In Greece, police reports and data from other sources indicate that use of illicit drugs was spreading in the late 1970s to young persons of all socioeconomic classes. Front-page newspaper articles alarmed the public and campaigns against drugs were initiated by lay groups.

This situation led the authorities to acknowledge the need for assessing the situation accurately. The Department of Psychiatry of Athens University was assigned the task of studying the extent of the drug problem in Greece and submitting proposals for appropriate preventive action.

The present paper presents an overview of illicit substance use among adolescent students in Greece, as well as related aspects such as smoking, alcohol drinking, and the use of licit psychotropic drugs without medical prescription.

Trends in licit and illicit substance use within the four years (1984–88) are also presented for Athenian high school students.

Methods

Nationwide Study

The sample is a nationwide multistage stratified probability sample. Urban areas were divided into three strata (Athens, Salonika, and all other urban areas); a fourth stratum consisted of all semi-urban and rural areas. Stage 1 of the sampling procedure involved the selection of urban, semi-urban, and rural locations, stage 2 the selection of high schools, and stage 3 the selection of classrooms within each high school. The allocation of the sample among the strata was proportional to the size of their student populations. The selection of sampling units in the first and second stages was proportional to their size. In each selected school, one class of about 30 students was selected with equal probability from each grade, and all students in the selected classes comprised the final sample.

The total sample consisted of 11,058 students ages 14–18 years attending the last four grades of high school. The secondary school system (high school) in Greece consists of six years; the first three years (Gymnasium) are compulsory and the second (Lyceum, either general or technical-vocational education) non-compulsory. Approximately 80 percent of Gymnasium students continue their studies in the Lyceum. The majority of schools are run by the state; only 6 percent are private fee-paying. The age of students in the Gymnasium is 12–14 years and in the Lyceum 15–18 years, with negligible deviations from this range. All 96 selected schools, representing all types of high schools, participated in the survey.

Data collection took place from March to May 1984. Students answered an anonymous questionnaire administered in their classrooms during two normal class sessions. The questionnaire consisted of structured pre-coded items covering a wide range of areas in addition to the use of licit and illicit substances: sociodemographic, school-related, physical and psychosocial health, life styles, future goals, personality and attitudes. Fa-

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ther's occupation and educational level as reported by the student were used in combination to assign students to three socioeconomic classes. This classification was validated by additional indices such as mother's educational level, housing, and estimated family income.

The average rate of absentees on the day of the survey was 6.1 percent. The participation rate of students present was 100 percent.

Reliability and validity of the responses concerning drug use were checked in a pilot study of 656 students conducted four months prior to the main study within the same school year. Students answered the questionnaire twice, with a 20-day interval, and questionnaires were matched by numbered stickers distributed at the first administration of the questionnaire.

Test-retest reliability coefficients were measured on 560 cases (85.4 percent of the total sample) for whom matching of the questionnaires was possible. Pearson's correlation coefficient for responses in seven categories ranged as follows: between .80 and 1.00 for tobacco smoking, drunkenness and lifetime and 12 month use of cannabis, cocaine, hallucinogens, and for 12-month use of heroin and opiates other than heroin; between .60 and .79 for lifetime and 12-month use of alcohol, stimulants, tranquilizers, hypnotics and for lifetime use of heroin and of opiates other than heroin, and .46 for lifetime use of heroin. Kappa coefficients[1] ranged as follows: between .71 and .89 for tobacco use and for lifetime and 12-month use of cannabis; between .41 and .50 for lifetime alcohol use, drunkenness, lifetime and 12-month use of hypnotics, for lifetime use of cocaine and opiates other than heroin and for 12-month use of tranquilizers; between .28 and .39 for 12-month alcohol use, lifetime and 12-month use of amphetamines, and lifetime use of heroin and tranquilizers. Reliability coefficients were significant at the .0001 level for 19 out of 20 usage variables examined and at .001 for the remaining one. No differences in reliability coefficients were observed between questions on drug use and other topics.

Validity was checked empirically by internal and external criteria:

- Rates of substance use and abuse in schools a priori known to have high rates of students with behavior problems and drug taking were compared with the rates reported in the remaining schools. Rates of reported experience with licit and illicit drugs proved to be substantially higher in the former schools for tobacco smoking, frequency of marijuana use in lifetime, last 12 months and 30 days, any use of heroin in the last 12 months and 30 days, any lifetime use of hallucinogens, opiates other than heroin, and lifetime and last 12 months' use of cocaine.
- 1.5 percent of the returned questionnaires were excluded from further analysis at the initial phase of checking because of major inconsistencies or unanswered parts of the questionnaires. In the retained questionnaires, internal consistency of answers was found to be very high, ranging from 85.5–100 percent.
- Urine was collected for the purpose of laboratory checking of general health status and substance use from 384 students in the four Athenian schools which participated in the pilot study. Students were informed of the general purpose of urine collection, but no specific mention was made of the substance tracing tests. Since anonymity was safeguarded, this procedure was in accordance with the ethical rules for investigations in Greece at the time. Urine samples were matched to questionnaires by the anonymous method of numbered stickers used in the test-retest procedure. Biochemical analysis for the detection of opiates, cocaine, and cannabis was performed by radioimmunoassay in the Instituto Superiori di Sanita (Rome). Results were positive for five of the 360 students for whom matching to questionnaires was possible: four were positive for cannabis and one for opiates. These five students had all responded positively to the pertinent questions but a further nine students (total rate 3.9 percent) reported use in the questionnaire without testing positive. Since reported use in the questionnaire covered the last 30 days while the bioassay techniques employed ensured detectability for only a few days following intake, some discrepancy in rates might be expected.

Study of Trends in an Athenian Sample

The sample in the 1988 survey consisted of classes from a randomly selected sub-sample of 18 schools from the 38 Athens area schools that had been included in the nationwide study of 1984. A total of 1,961 students participated in the survey. The average absentee rate on the day of survey was 5 percent.

A condensed version of the original questionnaire was used, covering only four out of eight categories of licit psychotropic drugs (tranquilizers, hypnotics, codeine, amphetamines) and three out of five illicit drugs (cannabis, heroin, cocaine). The same procedures were followed as in 1984 including test-retest reliability checks (135 matched pairs of questionnaires from 180 students over an interval of three weeks) and comparisons of rates of use in high-risk schools against the rest. Reliability and validity results were similar to those obtained in 1984.

Results

Nationwide Study

Over 70 percent of students reported having experimented at least once with tobacco smoking and 22 percent claimed regular smoking in the past month (Table 1). Regular smoking was highly correlated with sex and age, with more than one-third of the population smoking regularly in the older age group. The prevalence was much higher in the technical-vocational schools (41.9 percent vs 18.4 percent in public and 16.1 percent in private), in urban areas (23.7 percent vs 15.1 percent in semi-urban and rural areas), and lower in the higher socioeconomic level (19.4 percent vs 21.7 percent in the lower and 23.0 percent in the middle level).

The prevalence of alcohol use was 94.8 percent for past year and 82.4 percent for past month; 15.4 percent of students reported frequent alcohol use (10 or more times) in the past month. Rates of frequent alcohol use were twice as high in males as in females and nearly twice as high in the oldest as in the youngest age group (Table 1). Higher rates of frequent alcohol use were reported in private and technical-vocational in comparison to public schools (20.5 percent, 22.1 percent and 13.5 percent, respectively). Residence and socioeconomic level were not important determinants of the frequency of alcohol use. Heavy alcohol use (five or more drinks on one occasion) within the last 30 days was reported by 36.9 percent of students (44.4 percent male, 29.4 percent female) and increased from 32.2 percent in the 13–14 age group to 44.6 percent at 17–18 years.

Use of illicit drugs at any time was reported by 6 percent of students, with a ratio of two to one between boys and girls (Table 2). Approximately half of the users reported use more than twice.

The lifetime use of prescription requiring licit psychotropic drugs, without a doctor's order, was much higher than the use of illicit drugs, with a sex ratio of three girls to two boys. Nearly one-third (30.3 percent) of the student population reported that they had used unprescribed

TABLE 1—Tobacco and Alcohol Use by Sex and Age among Adolescents in Greece

		Sex		Age (years)		
	Total	Male	Female	13–14	15–16	17–18
Approximate Respondents (N)*	(10715)	(5354)	(5359)	(2708)	(5264)	(2734)
Lifetime smoking	%	%	%	%	%	%
Never	28.7	27.0	30.4	43.9	27.9	15.1
Once or twice	16.0	15.0	17.0	18.6	16.2	13.0
Occasionally	28.7	26.8	30.6	25.7	30.1	29.0
Regularly in the past	4.3	5.2	3.3	3.3	4.3	5.1
Regularly now	22.3	26.0	18.6	8.5	21.4	37.8
Past month frequency of alcohol use						
0 occasions	17.6	14.8	20.4	23.2	16.9	13.4
1–9 "	66.9	65.0	69.0	65.1	68.6	66.2
10–19 "	9.5	12.3	6.7	7.1	9.6	12.1
20–more	5.9	7.8	3.9	4.6	4.9	8.3

*Totals may differ because of small amounts of missing data.

TABLE 2—Lifetime, Past Year and Past Month Prevalences of Illicit and Unprescribed Psychotropic Drug Use (pills)* by Sex and Age

	Approximate Respondents (No.)	Illicit Drugs	Pills, not Illicit	Non-users
Lifetime	%	%	%	
Total rate	(10.812)	6.0	30.3	63.7
Sex				
Male	(5.396)	7.7	24.8	67.5
Female	(5.416)	4.0	35.7	60.3
Age (years)				
13–14	(2.741)	3.2	26.6	70.2
15–16	(5.312)	5.0	31.6	63.5
17–18	(2.752)	10.2	31.2	58.6
Past Year				
Total rate	(10.812)	3.8	16.5	79.7
Sex				
Male	(5.396)	4.8	12.4	82.8
Female	(5.416)	2.8	20.5	76.7
Past Month				
Total rate	(10.812)	1.7	6.3	92.0
Sex				
Male	(5.396)	2.3	5.5	92.0
Female	(5.416)	1.2	7.1	91.7

*Students were assigned according to their reported use of drugs to two mutually exclusive categories: (a) "Pills"—use *without* doctor's orders of licit psychotropic drugs requiring prescription (amphetamines, anticholinergics, tranquilizers, hypnotics, barbiturates, antidepressants, at least once and analgesics or codeine-containing syrups more than five times) *but no use of illicit drugs;* and (b) use of illicit drugs (cannabis, hallucinogens, cocaine, opiates other than heroin, heroin). In the last category students might have also used licit psychotropic drugs without doctor's orders.

pain relievers or codeine-containing syrups more than five times or another licit psychotropic drug at least once, but had never used any illicit drug. If users of illicit drugs are included, 34.7 percent had used a licit psychotropic drug without a doctor's orders.

The frequency of use of unprescribed licit drugs and illicit drugs is shown in Table 3. These very high rates of unprescribed licit drugs might to some extent be due to the possibility that the students, despite instructions, had included in these categories over-the-counter drugs for pain and cough relief, not requiring prescription.

Use of both licit and illicit substances increased significantly with age. High rates of illicit drug use were observed in males of the older age group (14.5 percent) and high rates of licit drug use in females of the older age group (40.6 percent). Illicit drugs were used in higher rates in technical-vocational schools (9.9 percent) compared to private (6 percent) and public (5 percent) schools.

The rate of illicit drug use was related to city size, ranging from 6.4 percent in Athens to 4.4 percent in semi-urban and rural regions. Rates of illicit use increased with socioeconomic level, although differences were less marked. The only demographic variables influencing use of licit drugs were sex and age.

Licit and illicit substance use was found to be highly correlated: 15.5 percent of regular tobacco smokers had used illicit drugs compared to 2.5 percent of the rest of the population; 10.5 percent compared to 3 percent had used three or more types of licit psychotropic drugs without doctor's prescription. Among heavy drinkers, 24 percent had used illicit drugs, compared to 2.1 percent of the rest of the population; 17.4 percent compared to 3.4 percent had used three or more types of licit psychotropic drugs without doctor's prescription. Of those who had used three or more types of psychotropic drugs without prescription, 77.8 percent had also used illicit drugs, compared to 3.9 percent of the rest of the population. Moreover, 69 percent of those who had used illicit drugs other than heroin and 82.4 percent of those who had used heroin reported use of licit psychotropic drugs without a doctor's prescription ("pills").

Trends in Licit and Illicit Substance Use in the Athenian Sample

Comparisons of rates of substance use are based on the 18 Athens schools which participated in both 1984 and 1988.

Age was defined differently in the two surveys (year of birth in 1984, age last birthday in 1988), but this should have had only a small effect on comparisons.

A decrease was found in regular tobacco smoking for boys and a lesser decrease for girls (Table 4). The decrease in regular smoking was most striking in the two younger age groups.

Alcohol consumption also decreased between 1984 and 1988 in both sexes. The decrease in alcohol use is mainly due to a reduction in the number of occasional users (those who had drunk less than 10 times in the last 30 days). The proportion of frequent users in the oldest age group actually increased slightly.

Lifetime prevalence of psychotropic substance use on doctor's orders showed a substantial decrease for codeine (from 45.6 percent to 22.5 percent), whereas no

TABLE 3—Frequency of Unprescribed Licit and Illicit Drug Use for Specific Drugs

	Life time			Last 12 Months			Last 30 days		
		Times			Times			Times	
Drug Use	Total %	1–2	≥3	Total %	1–2	≥3	Total %	1–2	≥3
Pain relievers	38.5	15.8	22.7	28.1	14.4	13.7	11.6	10.8	0.8
Codeine	24.9	13.5	11.4	12.3	9.2	3.1	4.1	3.4	0.7
Tranquilizers	10.0	6.2	3.8	6.4	4.0	2.4	2.6	1.7	0.9
Hypnotics	4.1	2.8	1.3	2.4	1.6	0.8	1.3	0.9	0.4
Amphetamines	4.5	2.9	1.6	2.8	1.8	1.0	1.4	0.9	0.5
Barbiturates	3.4	2.1	1.2	1.6	1.0	0.6	0.9	0.5	0.4
Antidepressants	2.5	1.7	0.9	1.6	1.1	0.5	0.6	0.4	0.2
Anticholinergics	5.2	2.7	2.5	2.9	1.6	1.3	1.3	0.6	0.7
Cannabis	3.9	2.3	1.6	2.7	1.6	1.1	1.2	0.7	0.5
Hallucinogens	1.1	0.7	0.4	0.7	0.4	0.3	0.3	0.2	0.1
Cocaine	1.6	0.9	0.7	1.1	0.6	0.5	0.6	0.4	0.2
Heroin	0.6	0.4	0.2	0.5	0.3	0.2	0.2	0.1	0.1
Opiates (other than heroin)	0.9	0.6	0.3	1.6	0.4	1.2	0.2	0.1	0.1

TABLE 4—Use of Tobacco, Alcohol, Illicit Drugs and Unprescribed Psychotropic Drugs (pills)* in 1984 and 1988 by Sex and Age

	Sex				Age (years)					
	Male		Female		13–14		15–16		17–18	
	1984	1988	1984	1988	1984	1988	1984	1988	1984	1988
Approximate Respondents (No)	(1065)	(1007)	(1060)	(922)	(571)	(265)	(1009)	(930)	(545)	(736)
	%	%	%	%	%	%	%	%	%	%
Regular tobacco smoking	23.9	20.3	21.8	20.7	8.2	2.6	22.1	13.0	39.6	36.3
Past month alcohol use										
No use	15.2	22.1	16.2	31.7	21.2	37.8	15.2	28.0	10.9	21.0
Occasional use (1–9 times)	63.4	57.8	72.7	58.5	66.4	56.7	69.2	59.2	67.5	57.5
Frequent use (10–19 times)	13.8	12.3	7.3	7.1	7.8	4.1	10.4	9.4	13.7	12.4
Very frequent use (20+ times)	7.6	7.8	3.8	2.7	4.6	1.4	5.2	3.3	7.9	9.2
Lifetime drug use										
Illicit drugs	6.5	8.1	3.8	3.9	1.7	0	4.7	4.3	9.7	10.9
Pills but not illicit	23.3	12.8	37.3	20.0	28.5	13.6	35.7	19.9	37.3	21.6
Non-users	70.1	79.1	58.8	76.1	69.8	86.4	59.7	75.8	53.0	67.5

*Students were assigned according to their reported use of drugs to two mutually exclusive categories: (a) "Pills"—use *without* doctor's orders of licit psychotropic drugs requiring prescription (amphetamines, tranquilizers, hypnotics, codeine-containing syrups) *but no use of illicit drugs;* and (b) use of illicit drugs (cannabis, heroin, cocaine). In the last category students might have also used licit psychotropic drugs without doctor's orders.

significant change was found for tranquilizers, hypnotics, and amphetamines.

Lifetime prevalence of licit psychotropic drug use without doctor's orders ("pills") was markedly reduced in 1988, to almost half of the rate observed in 1984. On the other hand, lifetime prevalence of use of any illicit drug showed an increase of 20 percent for boys (from 6.5 percent in 1984 to 8.1 percent in 1988), while current use (past month) rates of illicit drug use almost doubled in both sexes. More specifically, lifetime rates of use increased from 6.1 percent to 7.5 percent for cannabis, from 0.9 percent to 1.7 percent for heroin, and from 1.3 percent to 2.3 percent for cocaine.

Discussion

The nationwide survey of Greek high school students shows a rate of illicit drug use much lower than the rates of 10 to 23 percent reported during the first half of the 1980s in similar studies in other European countries[2–6]* and the rates of over 40 percent in the United States and Canada.[7–9]

Conversely, the overall use of licit substances such as tobacco and alcohol is higher in Greece than in the USA, Canada and northern European countries.[7,8,2,6,*] However, regular drinking is lower than in France,[10] and heavy drinking even lower than in the USA and Canada.[7,8]

The use of licit psychotropic drugs without a doctor's orders is much more common among the Greek students than the use of illicit drugs. In comparison to the US, the unprescribed use of opiates is more frequent in Greece, the use of tranquilizers is at the same level, and amphetamine and barbiturate use is less common.[7] Similar differences for the last three substances are found between Greece and Canada.[8]

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*Hibbel B: Trends in drinking and drug habits in Swedish youth. Paper presented at the 27th International Institute on the Prevention and Treatment of Alcoholism, Vienna, 1981.

The spread of licit and illicit substances among students in Greece is, as elsewhere, influenced by legal and societal factors. Greece is a producer of alcohol and tobacco and thus the use of these substances is widespread. The traditional pattern of alcohol use in Greece is cultural and recreational, with consumption during meals and festivities where drinking by younger members of the family is not generally discouraged. Although the availability of illicit drugs is rather high due to the fact that Greece is a pathway in the illicit trade between Asian countries and the West, the use of cannabis and other illicit drugs is considered as criminal behavior and subject to severe penalties. On the other hand strict regulations for prescribing and purchasing of psychotropics have been strongly implemented only recently. Access to psychotropic drugs was therefore rather easy at the time of the nationwide survey.

Trends in the last four years in the Athens area suggest a possible impact of policy and of social attitudes on the use of psychotropic medicines but little change in tobacco and alcohol use. Campaigns against unwarranted prescription of licit drugs and the unprescribed use of medicines, as well as the stricter implementation of laws regulating their provision, seem to have had a substantial effect on consumption of licit psychotropic drugs without prescription. The significant drop in rates of prescribed codeine use between 1984 and 1988 may also reflect increased awareness of medical professionals of the addictive aspects of the substance. Although there was some tendency toward the decline of regular tobacco and alcohol use among younger students and that of occasional alcohol use in all age groups, rates of more frequent use of alcohol were unchanged in the older age group. More frequent users may be more resistant to sociocultural pressure for change.

Greece does not seem to have escaped the first stage of the course of the epidemic of illicit drug use, before the leveling off or even the decrease of the phenomenon, as observed in other European and North American countries within the last decade. There has been a rapid expansion across barriers of age and social class although illicit drug use is still predominantly associated with males, as was also seen in a nationwide survey of the general population.[11] Along with the increased use of heroin and cannabis, the recent surge of cocaine use indicates that users in Greece are following closely the preferences and patterns of illicit drug use in western Europe and North America. ☐

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AIDS-Related Knowledge, Sexual Behavior, and Condom Use among Men and Women in Kinshasa, Zaire

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ABSTRACT

This study was conducted in 1988 among a random sample of 6,625 men and women of reproductive age in all 24 administrative zones of Kinshasa, the capital city of Zaire, to determine existing levels of knowledge regarding AIDS (acquired immunodeficiency syndrome), sexual behavior, knowledge and use of condoms in marital and extramarital relations; perceived risk of AIDS, and attitudes toward testing for the human immunodeficiency virus (HIV). Awareness of AIDS is almost universal, and the vast majority know the four main modes of transmission. Almost half believed in transmission by mosquitoes and in a vaccine or cure for AIDS. The majority of male respondents knew of condoms, but negative attitudes toward condom use are widespread, and few respondents perceived them to play a central role in combatting AIDS. (*Am J Public Health* 1991; 81:53–58)

Acquired immunodeficiency syndrome (AIDS) constitutes a major public health problem in Zaire. It is estimated that 6–8 percent of the adult population of Kinshasa, the capital city of Zaire, are seropositive, based on serosurveys of selected populations.[1] Six percent of babies delivered in the two major hospitals in Kinshasa in 1987 were born to seropositive mothers.[2] In 1988, 50 percent of the admissions to the internal medicine ward of the major public hospital, Mama Yemo, were HIV (human immunodeficiency virus) seropositive.[3] It is estimated that 80–90 percent of AIDS in Kinshasa is transmitted through sexual contact.[1] Since homosexuality is rare in Kinshasa, heterosexual relations constitute the major means of AIDS transmission among this population.

Until a vaccine or cure is found, public information and education remain an important weapon against AIDS. Since 1987, AIDS messages have been broadcast frequently on radio and television. Luambo, a popular singer in Zaire, further publicized the dangers of AIDS through a widely diffused song.

The current study was conducted city-wide in 1988 among the adult population to measure awareness of AIDS, its modes of transmission and means of prevention; coital frequency and extramarital sexual relations; knowledge and use of condoms; perceived risk of getting AIDS; and attitudes toward HIV testing. This module on AIDS formed part of a larger survey on contraceptive prevalence in Kinshasa, conducted by the Projet des Services des Naissances Désirables, the national family planning services project.

Methods

The projected sample for this survey consisted of 1,500 men (ages 20–59 years) and 1,500 women (ages 15–49 years), randomly selected from the 24 administrative zones of Kinshasa. The age criterion differed by sex, in an effort to obtain the population at greatest risk of AIDS. Four zones were intentionally oversampled for other research purposes (a field study to test the impact of an AIDS prevention program, not reported herein), bringing the projected sample size to 2,500 per sex.

Two-staged sampling was involved: first, 72 of 251 *quartiers* (the largest administrative unit within an administrative zone) were randomly selected and subsequently mapped; second, *parcelles* (a compound containing one or more households) were systematically selected. Men and women were interviewed in alternate *parcelles*; thus, the male/female data constitute independent samples, not husbands and wives.

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TABLE 1—Sociodemographic Characteristics of the Study Population*

	Men N = 3140	Women N = 3485
Age (years)	%	%
15–19	—	23.0
20–24	23.5	23.2
25–29	36.2	20.0
30–34	12.8	14.6
35–39	9.8	10.2
40–44	9.6	5.6
45 and over	8.1	3.2
Mean age (years)	33.4	26.6
Highest educational level attained		
None or primary	19.1	36.4
Secondary	61.0	60.5
Beyond secondary	19.5	2.7
Marital status		
Married (1 wife)	53.1	44.1
Married (2+ wives)	4.3	8.3
Consensual union	2.0	9.5
Separated, divorced, or widowed	3.6	8.5
Single, never married	37.0	29.5
Household amenities		
Has electricity	33.6	35.3
Has running water in house	9.2	7.8
Has toilet inside house	11.5	8.6
Has a working radio	51.8	49.3
Has a car or truck	9.4	7.0

*The "N" given in this and all subsequent tables is based on the unweighted sample (i.e. actual number of people who answered the question); the percentages are based on the weighted sample.

Because the average number of eligible respondents per *parcelle* was higher than expected, the total number of respondents (6,625) exceeded the projected sample. In the tables below, the results have been weighted to adjust for oversampling. The n in each case is based on the unweighted sample (actual number of people who were asked the question), whereas the percentages are based on the weighted sample.

Data collection for this survey took place from January to September 1988. All interviewers underwent a 20-day training course on sampling and data collection procedures prior to the fieldwork. All interviews were conducted in Lingala, the local language, by an interviewer of the same sex, using a pretested, structured questionnaire. Each interview lasted an average of 30-40 minutes.

All questionnaires were verified for completeness and logical consistency; where necessary, interviewers were sent back to the field to verify or complete responses. SPSS/PC + and BMDP/PC were used for the analysis.

Results

The total sample included 3,140 men and 3,485 women (Table 1). Over half of all respondents had at least some level of secondary education; however, significantly more men (20 percent) than women (3 percent) had gone beyond secondary school. The majority of men (59 percent) and women (62 percent) were married or living in consensual union.

Knowledge of AIDS

Awareness of AIDS is almost universal in Kinshasa (99 percent of men and 96 percent of women). Details of specific AIDS knowledge items are presented in Table 2. Of note, only half the study population knew that mosquitoes do not transmit AIDS and only 70 percent had correct information regarding casual contact. Ninety-four percent of men and 88 percent of women believed that AIDS could be prevented through behavioral changes.

Thirty-six percent of men and 45 percent of women at the time of this survey believed that there was a vaccine against HIV. Moreover, 40 percent of men and 21 percent of women believed that a person with AIDS can be cured. An additional 5–12 percent were unsure regarding both of these points.

Seventeen percent of men and 31 percent of women knew someone with AIDS at the time of the interview. Half of all respondents knew at least one person who had died of AIDS.

All respondents who had heard of AIDS were asked whether they had seen or heard something about AIDS via different communication channels. More adults in Kinshasa have been reached via radio than any other medium: 96 percent of men and 83 percent of women. Almost identical percentages of each group reported having heard the Luambo song on AIDS. A slightly lower percentage (86 percent of men, 70 percent of women) had seen something about AIDS on television. The percentages who had seen brochures, newspaper articles, or posters on AIDS were lower, ranging from 38–60 percent for men and 22–34 percent for women.

The vast majority of respondents, 95 percent of men and 89 percent of women, wanted to learn more about AIDS.

Multivariate Predictors of Knowledge of AIDS

In a multiple regression of the summed knowledge score by demographic and descriptive variables, males and females both had similar results (Table 3). Higher knowledge scores in both groups were associated with higher socioeconomic status (SES), higher educational attainment, length of time and number of messages they had heard about AIDS, personally knowing someone who has AIDS or had died of AIDS, and professing to a non-Christian religion. Being raised in a rural environment was negatively associated with knowledge for women, but not for men. Being older was negatively associated with knowledge for men but not for women. (In both males and females, age was negatively correlated with level of education.) Despite the number of significantly associated variables, the adjusted r square for both the male and female models was only 0.18. Thus, it is apparent that the variability seen in the knowledge scores in this population cannot be truly defined by the available variables.

Sexual Behavior, Knowledge, and Use of Condoms in Marriage

The median age at first sex (among those who had initiated sexual relations) was 17 years for men and 16 years for women. One percent of men and 14 percent women had not had sex, while 9 percent men and 4 percent women did not respond to the question.

All married respondents (N = 4,008) were asked whether they had had sexual

TABLE 2—AIDS Knowledge Items and Perceived Risk of HIV Infection among Those Who Have Heard of AIDS (percent with correct response)

	Men N = 3099	Women N = 3351
The AIDS virus is transmitted by:		
• eating unclean food	82.6	76.6
• transfusion with infected blood*	96.8	92.7
• mosquitoes	50.5	55.3
• sexual relations with an infected person*	98.7	96.4
• living in the same house with AIDS patient	66.5	56.6
• injection with unsterile needle*	95.7	91.3
• wearing used clothing	71.0	63.7
• working beside an AIDS victim	71.3	62.4
• (infected) mother to fetus*	94.0	89.2
The following are symptoms of AIDS:		
• frequent vomiting	63.5	63.5
• prolonged diarrhea*	81.6	81.7
• heavy bleeding for women	63.3	63.9
• recurrent fever*	45.2	43.2
• extreme weight loss*	78.2	68.7
• loss of hearing	75.2	73.6
• pain in the joints	57.1	56.1
• general, prolonged fatigue*	43.4	28.8
Transmission beliefs:		
• person can be infected without knowing*	87.9	77.5
• person can be infected without feeling sick*	84.5	73.1
• person who feels healthy could transmit the AIDS virus to another person*	84.2	72.1
• person with multiple partners has more risk than person with one partner*	78.9	72.6
• it is advisable for a woman infected with AIDS virus to get pregnant	97.4	95.7
• person infected with the AIDS virus will eventually get the disease*	76.0	71.2
There is a vaccine againt AIDS	58.6	43.1
AIDS can be cured	52.0	68.0
AIDS can be prevented*	93.7	88.0
AIDS can be prevented by:		
• taking antibiotics before sex	81.5	65.4
• using condoms for extramarital sex*	70.1	41.6
• going to a traditional healer	90.3	79.1
• avoiding sex with multiple partners*	93.7	85.4
Perceived risk of contacting AIDS:		
• Very high	10.6	10.2
• Moderate	6.8	5.9
• Low	21.0	9.3
• None	46.8	62.9
• Don't know	13.8	11.3

The asterisks above indicate which items are correct as stated.

relations in the previous month; 66 percent of 1,885 men and 60 percent of 2,123 women reported having had relations during this period. Abstinence was associated with the postpartum period or having an absent partner. Among those married respondents who had had relations, the mean number of days of sex during the previous week was 1.3.

Over 90 percent of married and single men, 77 percent of married women, and 61 percent of single women had heard of condoms. Despite the high recognition level, relatively few of the respondents in this survey had ever used condoms, with 12 percent of married men reporting ever using them with their spouse.

Eight percent of married men and 7 percent of married women reported current condom use with their spouse, although less than 2 percent of either sex reportedly used them "always" or "most of the time." The predominant reason for using condoms with one's spouse was to prevent pregnancy; the second, to prevent sexually transmitted diseases (STDs) in general, and the third to prevent AIDS. Mention of pregnancy prevention was higher among married than single respondents (reporting on condom use with their current partner), whereas singles cited prevention of other STDs and AIDS more often than married respondents.

Extramarital Relations and Use of Condoms

Twenty-three percent of married men and 1 percent of married women reported having had an extramarital partner or partners in the past six months; 12 percent of men and 1 percent of women reported such relations in the four weeks preceding the interview. Of men having had extramarital activity in the past six months, half reported having only one such partner (Table 4). Among the relatively few women who admitted to extramarital sexual activity, almost all claimed that it was with a single partner.

Factors associated with extramarital activity in men included younger age (<35 years), moderately higher education and SES levels, increased belief in the existence of a vaccine against HIV, and residence in a major urban area since adolescence. Men acknowledging extramarital activity also had slightly more misconceptions regarding false modes of HIV transmission, had heard more messages regarding AIDS than those denying extramarital activity, were more likely to cite condoms as a prevention method for AIDS, to perceive themselves to be at "very high" or "high" risk of AIDS, and to have known someone who had died of AIDS.

In women, the factors linked with such activity were more difficult to define, given the small numbers of women who acknowledged the behavior, but a few basic factors were similar to the men: younger age and urban residence since adolescence were associated with extramarital activity.

While the numbers are admittedly small, condom use was higher with extramarital partners (24 percent among men, 12 percent among women) than with one's spouse. In addition, the frequency of use was more consistent with extramarital partners than with spouses; half of the male users did so "always" or "most of the time." Among unmarried men, 27 percent reported having used condoms with their current partner, with a frequency of use similar to married men in their extramarital relations.

Attitudes toward Condoms

Over 52 percent of all male respondents believed that condoms tear easily during sexual relations, that they can stay in the vagina after sex, and that they diminish sexual pleasure. An additional 12–28 percent had no opinion on these questions. Single men were slightly more favorable toward condoms than married men.

TABLE 3—Multiple Regression of Summed Knowledge Score by Demographic Variables*

	Male		Female	
	Coeff	SE of Coeff	Coeff	SE of Coeff
Socioeconomic status	0.4488	0.0706	0.3709	0.0798
Age	−0.0295	0.0116	−0.0025	0.0136
Non-Christian religion	−0.2165	0.1008	−0.4542	0.1157
Multiple partners or extramarital partners	−0.0503	0.0680	0.6069	0.5444
Time source heard of AIDS/HIV	0.3650	0.0608	0.2405	0.0636
Number of information channels	0.4384	0.1027	0.8820	0.1240
Know someone with/died of AIDS	0.5844	0.1859	0.6707	0.2181
Rural residence	0.0384	0.1062	−0.3273	0.1245
Level of education	0.7765	0.1284	1.0612	0.2135
Marital status	0.2859	0.2275	0.1092	0.2193
	Adjusted $R^2 = 0.18$		Adjusted $R^2 = 0.18$	

*The knowledge score is based on one point for each correct answer to the items listed in Table 2 (except for "perceived risk").

TABLE 4—Frequency of Extramarital Relations and Condom Use among Married Respondents Who Have Heard about AIDS

	Men N = 1885	Women N = 2123
Number of extramarital partners in past 6 months		
0	77.4	98.6
1	11.7	1.3
2	5.6	0.1
3	2.9	-
4 or more	2.3	-
Percentage reporting extramarital relations in past four weeks	12.1	1.2
Among those with extramarital partners in past 6 months	(N = 401)	(N = 22)
% who use condoms with extramarital partners	24.0	11.8
Among these condom users the frequency of use	(N = 90)	(N = 4)
Always	35.4	(N too small to report %)
Most of the time	14.5	
Sometimes	27.4	
Never	22.7	

Among women, 30–50 percent believed that condoms have the above-mentioned disadvantages. However, well over 30 percent of both married and single women answered "don't know" to these questions, which could reflect their ignorance of the method, lack of experience with condoms, or embarrassment over the questions. Married women were slightly more knowledgeable or favorable than single women (data not shown).

Factors associated with condom use and with relatively positive attitudes toward condoms for men were younger age (<35), having had extramarital activity or multiple partners in the last six months, and not having a steady partner. Men with positive attitudes toward condoms were more likely to have used condoms and to cite condoms as a means of HIV prevention. Neither SES, education, religion, nor urban residence showed any association with condom attitudes (data not shown).

Perceived Risk of Getting AIDS

Table 2 shows the distribution of perceived risk in the male and female study populations. What is most striking is that 47 percent of men and 63 percent of women believed that they were at no risk of getting AIDS. For men, factors associated with an increased perception of risk include younger age, higher education and SES levels, knowing someone who died of AIDS, having less accurate knowledge regarding false modes of HIV transmission, having heard more messages regarding AIDS, being either Catholic or Protestant, and having had multiple sexual partners or engaged in extramarital activity in the last six months.

An increased perceived risk in women was associated with higher education and SES levels, engaging in extramarital activity or having multiple sexual partners, having heard more messages regarding AIDS and knowing of AIDS for a longer period of time, receiving their AIDS information from informal sources such as friends and neighbors, and knowing someone who died of AIDS. Women with high perceived risk also had less knowledge regarding common means of AIDS prevention and were slightly more likely to recognize that there is no available vaccine. Surprisingly, women who had a stable or regular partner also perceived themselves to be at increased risk versus those women without such a partner. This may be a reflection of female awareness of or concern over male infidelity.

The association of perceived high risk with misconceptions regarding modes of AIDS transmission and means of prevention suggests that at least a part of this perception may not be based on fact. However, considerable denial regarding AIDS risks is also playing a role in this population. Although having multiple sexual partners is a well-recognized risk behavior for AIDS, 74 percent of men actually engaging in extramarital relationships perceive themselves to be at little or no risk of AIDS.

Attitudes toward Testing for the AIDS Virus

Thirty-nine percent of men and 16 percent of the women had heard of the term "seropositive"; two-thirds of those who claimed to know the word defined it correctly. The majority of respondents, 78 percent of men and 57 percent of women, reported that they would accept being tested for HIV. Over 90 percent of respondents would want to be informed if either they or their spouse or child were diagnosed with AIDS or HIV infection.

TABLE 5—Perceived Risk of AIDS and Correlates of High Perceived Risk

	Men N = 3099	Women N = 3351
Perceived risk of contacting AIDS:	(%)	(%)
High	10.6	10.2
Moderate	6.8	5.9
Low	21.0	9.3
None	46.8	62.9
Don't know	13.8	11.3
Selected correlates of increased risk of AIDS (% with high or moderate response)		
Know person who has died of AIDS		
Yes	22.6	23.5
No	17.9	10.9
(p-value)	(0.03)	(<0.00000)
Multiple sexual partners in last 6 months		
Yes	26.3	32.6
No	16.4	19.9
(p-value)	(0.00001)	(0.05)
Number of AIDS messages heard		
1–3	10.7	16.5
4 or more	22.3	24.5
(p-value)	(<0.00000)	(0.0002)
In relationship with a stable partner		
Yes	19.7	21.2
No	21.0	14.4
(p-value)	(NS)	(0.0005)

Discussion

The results of this study provide the first available data on levels of knowledge and attitudes with regard to AIDS among a probabilistic sample of the adult population of Kinshasa. While awareness and knowledge may have increased since the study ended in September 1988, the results nonetheless constitute a useful basis for the planning and evaluation of future information-education-communication (IEC) activities for AIDS.

Awareness regarding transmission of HIV via sexual contact is very high, but misconceptions persist over transmission by casual contact and mosquitoes. The fact that only a relatively low percentage could identify symptoms of AIDS may be explained by the fact that health officials have not stressed these aspects in their educational messages.

The misconceptions among a significant portion of the population regarding a vaccine and cure for AIDS are reason for concern, since they may create a sense of false security. The belief regarding the vaccine may result from periodic news stories about vaccine research ongoing in Zaire. The belief that AIDS can be cured may also be attributable to the widespread publicity about a new drug "MM1," which was presented to the Zairian public in November 1987 as a treatment for AIDS. Two recent surveys in different populations have shown a drop over the past year in the percentage that believe in a vaccine and/or cure.[4,*]

Comparisons between the Kinshasa population and a May-June 1988 nationwide survey of the adult population in the United States[5] reveal that both populations were highly knowledgeable on modes of transmission and reported a high level of exposure to AIDS messages via the mass media; in Zaire the most far-reaching channel was radio, whereas in the US it was television.

However, the two populations differed markedly in several other respects: belief in a vaccine or cure for AIDS was far more common in Zaire, while belief that condoms were effective prevention measures was less common in Zaire. These differences also underscore the areas in which campaigns in Zaire will need to be more explicit.

This study is the first to provide data on two key variables related to HIV transmission—extramarital relations and condom use—from a large, probablistic sample of both men and women in Zaire. The responses to the questions on sexual behavior should be interpreted with some caution, however, as such items are highly sensitive.[6] Based upon anecdotal evidence from Kinshasa residents, it was initially believed that the current data underestimated both coital frequency (median number of days of sex per week: 1.3 for married respondents) and extra-marital relations (23 percent of married men and 1 percent of married women in the past six months).

However, our findings are similar to results obtained from a study of over 12,000 workers and their spouses in two businesses in Kinshasa.[7] Among, 4,487 married couples, the mean number of days during the past year in which the couples had sex was 84; this yields a mean of 1.6 days per week. Regarding extramarital sex, 29 percent of married men reported at least one extramarital partner in the past 12 months. This percentage is slightly higher than that found in our study but covers a 12-month rather than six-month period. The question of extramarital relations was posed to females at only the smaller of the two study sites and yielded a prevalence similar to ours (<2 percent).

By contrast, in a study of health personnel (ranging from doctors to traditional practitioners) from all regions of Zaire except Kinshasa, the percentage of men reporting a history of extramarital relations in the past was 58 percent in 1987, dropping to 43 percent in 1988; among women, these percentages were 29 percent in 1987, decreasing to 18 percent in 1988.[8] These percentages are substantially higher than those found for the Kinshasa population in general. Possible explanations for these differences could be that the time period for the activity was not clearly specified, the health workers had greater economic means with which to engage in such activities, or they felt more comfortable with the circumstances in which the information was obtained.

We believe that the data from the current study underestimate the extent of extramarital relations, especially among women. In a subsequent study of sexual behavior in Kinshasa based in part on focus groups, both male and female participants were asked whether married men and married women would be likely to answer truthfully to questions regarding extramarital relations on a survey. The general consensus was that it depended on the interviewer's skill at putting the respondent at ease. However, there was strong consensus that a married woman

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[*] Bertrand J, Bakutuvwidi M, Balowa D, Kinavwidi N: Knowledge of AIDS, sexual behavior and condom use in ten sites in Zaire. American Public Health Association annual meeting, Chicago, October 1989.

could not risk revealing anything about extramarital affairs, lest this get back to her husband.**

The findings with regard to knowledge and use of condoms among married women concur with previous studies in Zaire.[9-11] In addition, the data from the current study confirm the widespread supposition that condoms are used much more frequently for extramarital sex than for relations with one's spouse. Despite the fact that relatively few men report having used condoms, the majority claim that they tear, stay inside the women's vagina, and decrease sexual pleasure. These negative attitudes must be based on conjecture rather than experience. Unsubstantiated rumors have apparently discouraged the use of condoms to such a degree that the Zairian public does not perceive their importance in the fight against AIDS. The percentage of married men and married women reporting current condom use yielded very similar results from two independent samples. This refutes the hypothesis that women tend to underreport condom use (at least for relations with one's spouse), an issue which has been raised in connection with female-only contraceptive prevalence surveys.

Regarding perceived risk, most of the individuals engaging in extramarital and multiple partner sexual activity did not acknowledge any perception of risk, even though the majority of these same people intellectually "know" that sexual activity with multiple partners provides an elevated risk of HIV exposure. In addition, many persons with high perceived risk believed in the possibility of mosquito-born and/or casual transmission. An unfounded perception of risk, such as this, may be counterproductive in the course of HIV infection and AIDS. If people persist in fearing casual contact with infected individuals, the subsequent ostracism of such persons will place an unmanageable burden upon limited governmental resources. It may also limit the population's response to efforts to promote behavioral change.

To conclude, the findings from this survey have several important implications for ongoing and future efforts to prevent the spread of AIDS in Kinshasa:

- Greater efforts are needed to combat the still prevalent misconceptions that AIDS can be transmitted by casual contact and by mosquitoes.
- IEC efforts should reinforce the idea that the two main means of protection from sexually transmitted HIV infection or AIDS are total mutual fidelity within monogamous couples and where that is not considered possible, use of condoms.
- Condom promotion should include messages directed at changing the negative attitudes toward condoms reflected in this study.
- Information campaigns should emphasize the fact that there is no effective vaccine against AIDS and that the disease is fatal.
- Education campaigns should be directed at teens as well as adults; by the age of 17, half of males and females have engaged in sexual relations. ☐

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The Course of the HIV Epidemic among Intravenous Drug Users in Amsterdam, The Netherlands

ABSTRACT

To determine if behavioral changes in intravenous drug users in Amsterdam have retarded the HIV (human immunodeficiency virus) epidemic in this group in recent years, we report that: HIV-antibody seroprevalence in annual samples of injectors has been constant over the years 1986–89; HIV-antibody incidence in a cohort of injectors appears to have decreased from 1986 to 1987 and stabilized after that until 1989; acute hepatitis B incidence in all drug users in Amsterdam declined rapidly between 1985–89. It is concluded that changes in drug use behavior so far appear to have resulted in a stabilization of the epidemic among injectors, at a level with a still disturbingly high incidence rate of 5–6 per 100 person-years. (*Am J Public Health* 1991; 81:59–62)

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Introduction

Intravenous drug use was the only risk factor in 75 (7 percent) of the 1,074 AIDS (acquired immunodeficiency syndrome) cases diagnosed and reported in The Netherlands by December 31, 1989. Forty-five of these cases were residents of Amsterdam (P. Bindels, personal communication). Although the absolute number of AIDS cases among intravenous drug users in this city of approximately 700,000 inhabitants is still relatively small, the rate of the recent increase is high: from one new case in 1985, three in 1986, eight in 1987, and 15 in 1988 to 18 new cases in 1989. In an effort to stop or slow down the spread of HIV among drug users, a number of national and local policies have been developed and applied. The informational programs directed to drug users, on the dangers of AIDS and on ways of preventing infection (since 1986), were supplemented by supplying condoms to addicted prostitutes. In 1984, a needle and syringe exchange program was implemented,[1,2] the original purpose of which was to prevent the spread of hepatitis B. All of these policies aim at voluntary behavioral change, by reducing risk behavior and thereby limiting the occurrence of new HIV infections. Evidence based on self-reporting suggests that behavioral change toward safer drug using practices did indeed occur in Amsterdam in recent years. A study previously published in this Journal,[3] showed that in a cohort of intravenous drug users a marked increase in making exclusive use of the Amsterdam needle and syringe exchange program occurred during the period December 1985 through July 1988 with a concurrent marked reduction in sharing used needles and syringes. Self-reported changes in behavior have their limitations and more objective measures of risk reduction are needed to corroborate these findings. The aim of this study therefore is to describe several of these more objective indicators for the development of the HIV epidemic among drug users in Amsterdam during the past few years.

Three indicators will be dealt with: 1) HIV seroprevalence among intravenous drug users at intake into a study from 1986 through 1989; 2) incidence of HIV infections in a cohort of intravenous drug users from 1986 through 1989; and 3) incidence of acute hepatitis B infection among drug users in the city of Amsterdam from 1983 through 1989. In drug users, hepatitis B virus (HBV), like HIV, is transmitted mainly through the sharing of needles and syringes. Acute hepatitis B infection was therefore chosen as a surrogate marker for HIV infection. In homosexual men, where both HBV and HIV also share the same main transmission mode (anogenital intercourse), a close correspondence between hepatitis and HIV incidence was shown.[4]

Methods

Study Participants

Participants were recruited at six methadone maintenance outposts and at a weekly sexually transmitted diseases

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TABLE 1—HIV-antibody Prevalence and Presence of Independent Risk Factors in Annual Samples of IVDU in Amsterdam

Independent Risk Factors*	1986 (N = 220)	1987 (N = 178)	1988 (N = 133)	1989 (N = 91)
% first injection > 5 years ago	75.0	73.4	66.2	71.4
% last injection in past week	61.2	57.6	58.6	57.1
% German nationality	20.0	18.5	16.5	17.6
% residing in Amsterdam > 2 years	72.3	75.8	72.2	78.0
% smoking of heroin not daily	84.5	78.0	83.5	76.9
% HIV-ab positive†	33.2	30.3	27.8	31.9
% adjusted **HIV-ab positive	33.2	31.0	31.2	34.1

*Presented categories are associated with a positive HIV-ab test.

**Calculated, using regression coefficients for the different years from a logistic model where all listed risk factors were included, with 1986 as arbitrary year of reference.

†χ^2 test for trend p = 0.54

clinic for drug-using prostitutes. Both intravenous and non-intravenous drug users were invited to participate. After informed consent was obtained, a blood sample for HIV serology was taken and participants were interviewed using a standard questionnaire. Participants were asked to return for follow-up examinations every four months for repeat interviews and blood samples. There was no payment for their first visit; those who continued participation in the study were offered 25 Dutch guilders as an incentive for each follow-up visit. HIV antibody tests were performed using standard procedures described elsewhere.[5] The intake of participants started December 1985 and continues to the present.

Results reported here pertain to the period January 1986 to the end of 1989. Participants who reported at intake ever having used drugs intravenously were considered intravenous drug users (IVDUs) and were all included in the HIV-seroprevalence analysis. The HIV-incidence analysis was limited to those follow-up participants who had used drugs intravenously within the five years preceding intake or who (re-)started intravenous drug use in the course of follow-up. IVDUs with a positive HIV-antibody test result at entry were more inclined to take part in the follow-up than those who tested negative; 69 percent versus 57 percent, respectively, returned for at least one follow-up visit by March 1990. Risk factors for the presence of HIV-antibody that were more often present in those in follow-up than in others were: recently injecting, residing in Amsterdam for more than two years, and German nationality.

HIV-Seroprevalence and -Incidence

The development of the HIV-seroprevalence rate over time was examined by separating the intakes according to year of intake (1986–89). Since participants were self-selected, it is conceivable that IVDUs with different probabilities of being seropositive entered the study at different times. To control for such a selection bias, predetermined risk factors[5] that predict the probability of being seropositive and that were presumed not to reflect policy-induced behavior changes were multivariately controlled by logistic regression, using standard statistical software.[6] These risk factors were: date of first and date of last injection, nationality, length of stay in Amsterdam, and frequency of smoking of heroin in past six months. Annual incidence rates were calculated by determining the number of seroconversions per 100 person-years for those at risk. At risk were considered IVDUs who were HIV-antibody negative at entry, from their first visit until their last one or until seroconversion. Date of seroconversion was estimated as the midpoint of date of last seronegative visit and date of first seropositive visit.

Incidence of Acute Hepatitis B

All cases of acute hepatitis B in Amsterdam must be reported to the Municipal Health Service. On a routine basis, background data including drug use are collected in a personal interview by a public health nurse. This procedure remained unchanged throughout the study period. All records of acute hepatitis B cases from 1983 through 1989 were carefully screened by one of us (CB) for cases with a history of illicit drug use. Incidence was calculated by using estimates of the total number of hard drug users present per year as denominator; these estimates were calculated by the Municipal Health Service's drug department, based on a capture/recapture method quarterly[7] and have wide margins of uncertainty. We assumed there was a constant proportion of injectors among these drug users during the study period.

Results

HIV-Seroprevalence

A total of 622 subjects who had ever used drugs intravenously participated in the study between January 1986 and December 1989 (Table 1). In four consecutive years (1986–89), both the crude HIV seroprevalence rates and the adjusted rates (taking 1986 as year of reference) remained between 27.8 percent and 34.1 percent with no trend effect (Table 1).

HIV-Incidence

A total of 236 subjects who were seronegative at entry into the study and who reported intravenous drug use either within the five years preceding entry or in the course of follow-up, were analyzed to determine incidence. Twenty-seven seroconversions were recorded: five in 1986, six in 1987, eight in 1988, and eight in 1989.

The incidence rates per 100 person-years (95% confidence interval) were: 10.7 (1.3, 20.0) in 1986, 5.6 (1.1, 10.1) in 1987, 5.6 (1.7, 9.5) in 1988, and 5.5 (1.7, 9.4) in 1989 (Figure 1). The incidence rate difference between 1986 and 1987 was 5.0 (−5.3, 15.4).

Acute Hepatitis B Incidence

The incidence of acute hepatitis B (AHB) per 10,000 varied from a high of 48 in 1984, to a low of 8.6 in 1989 (Figure 2). Over the seven-year time span under study, there was a significant decline in AHB incidence (χ^2 for trend = 23.5, df = 1, p = 10^{-6}).

Discussion

These data suggest a decline in HIV-seroconversion from 1986 to 1987, followed by stabilization up to 1989. The confidence intervals, however, are broad, indicating that the early decline is not conclusive. In San Francisco, a similar decline was noticed in HIV seroconversion rate per 100 person-years in IVDUs: from seven in 1985 to 2.4 in 1987.[8] It is very difficult to evaluate properly the impact of behavioral change among IVDUs in Amsterdam, by comparing it with studies being done in other countries. Generally, because large segments of the total population of IVDUs are hard to reach, very little is known about the representative-

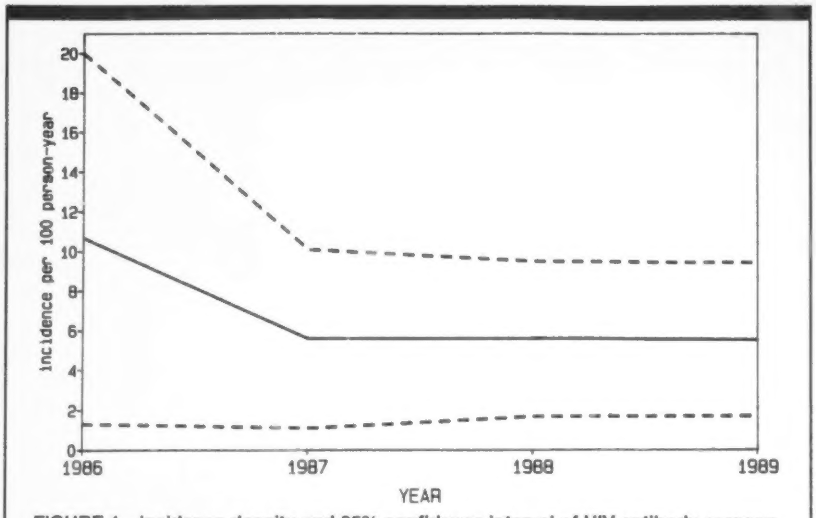
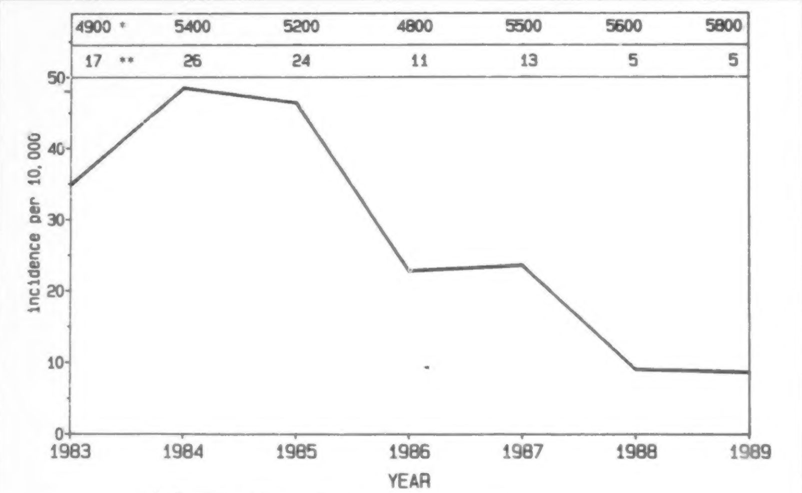


FIGURE 1—Incidence density and 95% confidence interval of HIV-antibody seroconversion in IVDU per year, 1986–89



* Rounded estimates of number of drug users per year
** Number of new acute hepatitis B cases per year

FIGURE 2—Estimated incidence of acute hepatitis B per 10,000 drug users in Amsterdam, The Netherlands, 1983–89

ness of IVDU study samples; ours is no exception. Participants were self-selected and follow-up was poor; only 57 percent of HIV-antibody negative IVDU at entry returned for at least one follow-up visit. Continued participation in the study may be of more interest to those IVDUs who have not modified their risk behavior and therefore may suspect a change in their serostatus since their last test. For this reason we may be overestimating HIV incidence in IVDUs in Amsterdam when generalizing from this group. On the other hand, we have evidence that behavioral change did occur especially in those drug users who took part in the follow-up study.[3]

We found rather stable HIV seroprevalences over the years, both for the crude prevalences and after attempting to correct for the influence of selection biases following from our sampling procedures. Stable HIV seroprevalences among IVDUs in recent years have been reported from many cities in North America and Western Europe.[8–16] The interpretation of this phenomenon, however, and especially measuring the impact of behavior change by monitoring seroprevalence, is very difficult since many factors that affect the general IVDU population and that are generally not well recorded—for example loss of seropositives for various reasons (mortality, hospitalization, moving, cessation of drug use, etc.) and entrance of new seronegative injectors—have to be taken into account. As appears from our data and as was reported before from Manhattan, New York City,[9] a stable seroprevalence is still compatible with a rather high incidence.

Throughout the study period the same technique was applied to estimate the number of drug users in the city and reporting requirements for acute hepatitis B remained the same. We therefore consider it unlikely that the marked decrease in acute hepatitis B observed in drug users is an artefact, i.e. the result of a change in these procedures. From the United Kingdom a similar decrease in acute hepatitis B incidence in drug users since 1985 has been reported.[17]

In conclusion, we found a modest decrease in HIV incidence among IVDUs participating in our follow-up study which correlates with the earlier reported behavioral change in this group.[3] The decline in acute hepatitis B incidence is a convincing indicator of effective behavior change. The largest drop in hepatitis incidence appeared before 1987, a period about which we have very limited data on HIV prevalence and incidence. Possibly a parallel reduction occurred in HIV incidence in that period that we were not able to measure. Nevertheless, recent HIV incidence rates still appear to be disturbingly high, indicating that transmission among this group is continuing. ☐

Acknowledgments

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ANA Releases Draft Report for Health Care Reform

After nearly two years of effort devoted to the development of a reform plan for health care delivery in the nation, the American Nurses' Association (ANA) has released a working draft of the report "Health Care Reform: An Agenda for Action" for review and comment. ANA President Lucille Joel describes the plan as achievable, realistic and cost-effective.

ANA expects to release the report to the public early in 1991, after study by the association's 53 constituents, elected and appointed officials, participants in the ANA Nursing Organization Liaison Forum, and the Tri-Council for Nursing. In this way, ANA expects that the report will reflect an agenda on behalf of the entire nursing profession.

Joel says, "Nursing's plan for health care reform represents a massive effort on behalf of the entire profession to clearly lay out what the nation's nurses believe to be a plan for the delivery of health care services that best meets the needs of the public." The plan offers solutions to many problems affecting the US health care system, including access to care; the lack of or misuse of appropriate providers, settings and delivery arrangements; equitable and affordable financing; and stronger cost controls.

Recognizing that cost and revenue estimates are critical components of health care reform and that adequate funding sources must be available, the ANA plan provides an example for financing. Unique characteristics proposed in the working draft include:

- federal standards to assure access by all to basic levels of health services through public and private health service plans;
- implementation of the plan through incremental steps to be completed by the year 2000 with an initial focus on pregnant women as well as infants and children;
- renewed emphasis on schools, places of work, the home, and other community settings for the delivery of care; and
- reliance on multiple payors—individuals, employers and government—to finance the reformed system.

ANA's Board of Directors planned to review comments received from the nursing community at its December meeting. After approval by the board the plan will be prepared for wide dissemination. For further information, contact ANA, 2420 Pershing Road, Kansas City, MO 64108.

Predictors-of Successful Aging: A Twelve-Year Study of Manitoba Elderly

Noralou P. Roos, PhD, and Betty Havens, MA

ABSTRACT

In Manitoba, Canada, a representative cohort of elderly individuals ages 65 to 84 (n = 3,573) were interviewed in 1971 and the survivors of this cohort were reinterviewed in 1983. This analysis assesses the determinants of successful aging—whether or not an individual will live to an advanced age, continue to function well at home, and remain mentally alert. Over 100 separate indicators of demographic and socioeconomic status, social supports, health and mental status in 1971 were available as potential predictors of successful aging. Indicators of access to health care over the period 1970–82 and indicators of diseases over this period were also available as predictors.

Those who aged successfully were shown to have greater satisfaction with life in 1983 and to have made fewer demands on the health care system than those who aged less well. Despite the large number of potential predictors of successful aging which were examined, only age, four measures of health status, two measures of mental status, and not having one's spouse die or enter a nursing home were shown to be predictive of successful aging. (*Am J Public Health* 1991; 81:63–68)

Introduction

The elderly are not a homogeneous group. Some are beset by multiple chronic and/or acute conditions and spend considerable time in hospital. Still others, especially women, live a very long life but are afflicted by increasing frailty or declining mental status, passing their last years in nursing homes. Some elderly manage to avoid all of these scenarios, maintain themselves independently in the community and are described as "aging successfully."[1,2]

While other investigators have attempted to study successful aging, our analysis is unusual in its longitudinal design, its large representative sample, and in focusing on successful aging of an already elderly cohort. It addresses three questions:

1. What proportion of an elderly cohort will age successfully?
2. What are the health care expenditure patterns associated with successful aging?
3. Which characteristics of individuals predict successful aging? (From among all those interviewed in 1971, who will successfully age? And among those who survive to 1983, what are the factors which predict successful aging?)

Methods

In 1971 a large (N = 3,573) representative sample of individuals ages 65–84 living in the community was interviewed as part of the Manitoba Longitudinal Study on Aging.[3,4] In 1983 and 1984 survivors of this cohort were reinterviewed. In addition, the health care expenditures of this cohort over the period 1970 through 1983 were available from administrative records of the universally insured provincial health care program.

The sample was selected as follows: 2.5 percent of the residents of urban areas and 5 percent of the residents of nonurban areas. Analyses were reweighted by the sampling proportions within strata to reflect population figures. A place of residence variable (urban/not) was included in each multivariate model to control for sampling fraction.

Individuals were excluded from the analysis if they were not resident in the province (as judged by coverage in the health care system) for the period of the study, 1970 through 1983 or until death (310); if they were alive and resident in the province in 1983 but not reinterviewed (147); or if the 1971 or 1983 interview was conducted entirely through a proxy (101). (Proxy interviews were used primarily where individuals were too ill or confused to respond.) Native Manitobans (90) were also excluded from the analysis. The final sample for this analysis included 2,943 elderly. A comparison of baseline characteristics of those included and excluded in the study found no difference in age and sex or self-reported health status. However, the interviewer was significantly

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more likely to rate the respondent's mind as steady or strong in general for those retained in the study.

Successful aging was defined using the 1983 reinterview as follows:

- Alive in 1983.
- Not resident of a nursing home in 1983.
- Did not receive more than 59 days of home care services in 1983.
- In the 1983 interview:

Rated health excellent to fair.
Not dependent in any activities of daily living (getting in and out of bed, dressing, bathing, eating, using stairs).
Did not use a wheelchair.
Did not need help in going out doors.
Able to walk outdoors.
Scored seven or more correct answers on Mental Status Test.
Interviewer judged respondent's state of mind to be steady and strong or a bit weak only after some interview time had elapsed.

Cause of death was taken from death certificates. Less than 1 percent of the individuals (N = 26) died of accidents, poisonings, or violence and therefore lost the chance to age successfully.

Claims data have been shown to provide a highly accurate, reliable, and valid representation of health care use.[5,6] Claims were used to estimate health care expenditure patterns associated with healthy aging over the 14-year period 1970–83 (or until death). The following types of utilization were tracked: days spent in hospital (with days spent in intensive care treated separately); days spent in nursing home; days enrolled in the home care program; all physician visits and surgical fees (for both inpatient and outpatient procedures).

Since nursing home services in Manitoba have been universally insured only since 1973, costs incurred by nursing home residents prior to July 1973 were estimated as described elsewhere.[7] Since September 1974, home care services in the province have also been universally provided at no charge to consumer.

Manitoba hospitals and nursing homes are funded on the basis of global budgets.[8] An estimate of mean costs per day in hospital ($322) and nursing home ($49) was calculated by dividing total Manitoba Health Services Commission payments (including capital repayment) to hospitals and to nursing homes in fiscal 1984 by the number of days of care produced that year by these institutions. The cost of a day in intensive care was estimated to be $1,610, five times the cost of a hospital day. Although per diem costs escalated markedly in both the hospital and nursing home sectors over the time period studied, constant dollar costs were used. The estimate of home care costs per day ($4) were derived by dividing service costs per user over a six-month period by the 182 days in that period.[9] Total payments for physician visits and consultations were divided by the total numbers of visits to obtain an average cost per visit ($17). All costs are in constant 1984 Canadian dollars.

Variables available from the 1971 interview represent potential predictors of successful aging, while diagnoses made during physician visits over the period 1970 through 1982 and variables constructed from administrative records recording events occurring to spouse (death or admission to nursing home) during this same period are potential factors associated with successful aging. Thus predictors of successful aging may include characteristics of the individual's demographic, ethnic and cultural background, socioeconomic characteristics, and characteristics of the support network. The individual's mental status was also assessed in 1971, as well as satisfaction with life, and several characteristics of health status. Factors studied for association with successful aging include changes in the individual's support network over time (whether the individual's spouse predeceased him or her and whether the spouse entered a nursing home prior to the interviewee's death or 1983).

The extent to which specific diseases pose threats to successful aging was examined using both self-reports in 1971 and claims-derived measures of physician contact for five conditions judged to place an elderly individual at "risk for recovery."[10] The Manitoba Cancer Registry was used to determine whether the individual had been diagnosed as having cancer (other than skin). Whether individuals had regular contacts with physicians (and therefore would be available for the early detection and treatment of disease) was measured by the percent of years the individual was alive between 1970 and 1982 during which one or more (or two or more) visits were made to physicians. (See Appendix for a complete listing of predictor variables.)

Two dependent variables were examined: successful aging (yes-no); and successful aging versus survival to 1983 in a dependent state.

In the analyses, using the first dependent variable, all individuals sampled were used to determine which variables were predictive of successful aging. The second analysis examined the association between all dependent variables and successful aging among those who survived to 1983.

Because of the large number of independent variables, a two-step process was followed for each group of variables (see Appendix for grouping). First, the relation of each variable to each dependent variable was tested by univariate analyses. A forward step-wise fitting algorithm for the multiple logistic regression model was used to determine which variables among each group of predictor variables made a contribution to each model at a p value level of 0.05. Age and sex were included in every model. From among those variables within a set which were substantially correlated with one another (i.e. absolute value of Pearson correlation coefficient .5 or greater) only one was selected for modeling. The variables which made the most contribution to model fit, or, where there was little difference, the variables most commonly used in previous studies were selected.

A final multiple logistic regression model was fit including the variables from each set selected as described above. Contributions to the model of the combined effect of 1) sex and income, 2) sex and spousal death/nursing home entry, 3) income and spousal death/nursing home, were assessed by including interaction terms in the model.

The data were randomly split with one-half of the records used to develop the models and to estimate the coefficients of the logistic regression models.[11] The final model was tested on the other half of the records to see if the same variables entered the model and whether the coefficients were estimated in similar magnitude. All data have been pooled for presentation since the larger sample provides more stable estimates of the coefficients.

Results

By our definition, 20 percent of those individuals ages 65 to 84 interviewed in 1971 were judged to have successfully aged in 1983, 22.6 percent were alive but dependent, and 57.5 percent were deceased (Table 1). Males were more likely to be deceased by 1983 than females. Although females ages 65 to 74 were somewhat more likely to have aged success-

TABLE 1—Characteristics of Individuals in 1983 by Age in 1971

	Age in 1971				
	65–74		75–84		
Characteristics of Individual in 1983	Male %	Female %	Male %	Female %	All %
Has successfully aged	24.0	31.5	7.0	5.9	20.0
Alive but dependent	19.9	29.8	12.3	24.4	22.6
Deceased	56.1	38.7	80.7	69.8	57.5
Number (N)	908	930	521	584	2943

TABLE 2—Satisfaction with Life in 1983 in Those Defined as Successfully Aged versus Those Alive but Dependent

	Characteristics of Individuals in 1983		
Satisfaction	Aged Successfully	Alive but Dependent	N
In 1983, how would you describe your satisfaction with life in general at present?			
Excellent	69.6	30.4	182
Good	60.5	39.5	556
Fair	46.9	53.1	193
Poor-Bad	18.1	81.9*	40

*Mantel Haenszel Trend Test: $p < .001$

TABLE 3—Total Health Care Expenditures over Period 1970–83 by Individuals' Differing 1983 Health Status

	Characteristics of Individuals in 1983			
	Aged Successfully	Alive but Dependent	Deceased	All
Total Health Resource Use* 1970–83 or to Time of Death (%)				
0–$10,000	67.7	30.5	23.5	33.9
10–25,000	20.7	18.4	22.1	21.0
25–50,000	9.5	19.6	21.8	18.8
50–100,000	2.0	14.0	17.0	13.3
$100,000 or more	0.1	17.5	15.7	13.0
Mean Resource Use per Individual (in $ over Period 1970–83 or to Time of Death)				
Total use ($)	10304	53906	50643	43354
Use per year lived ($)	736	3850	5955	4441
Number	583	666	1694	2943

*Resource use is estimated in 1984–85 Canadian dollars as follows: $1,610 per day in intensive care, $322 per hospital day, $49 per nursing home day, $17 per physician visit, $4 per day on home care, and actual $ amount for surgical procedures.

fully than males, there was little difference in successful aging by sex in the older age group ($p = .466$). Recalculating the percentages in Table 1 (not shown) and focusing upon those who survived to 1983 shows no difference in the percentage of females versus males in the youngest group who successfully aged ($p = 0.172$). However, among survivors in the oldest age group, males were more likely to successfully age than were females (32.7 percent versus 18.0 percent, $p = 0.006$).

Remaining independent (the definition of successful aging) is associated with a higher level of satisfaction with life in older age (see Table 2). Separate comparisons by age confirmed this relationship (data available on request to author). However, maintaining functional independence is not a guarantee for being satisfied with one's life in advanced old age. Moreover, losing one's independence is not necessarily judged a disaster. Among those reporting their satisfaction with life to be excellent, 30.4 percent were classifed as "alive but dependent" in 1983.

Individuals who remained independent made markedly fewer demands on the health care system (Table 3). About two-thirds (67.7 percent) of those aging successfully used less than $10,000 worth of health care resources over the 14-year period 1970 through 1983, averaging $736 per year. In contrast, those who lived to 1983 in a more dependent state averaged $3,850 per year over the 14-year period. Those who died before 1983 had the highest resource use averaging $5,955 per year lived. Further analyses (not presented in Table 3) demonstrated that the low resource utilization patterns of those aging successfully were observed both for males ($768 per year lived) and females ($710) and were independent of age ($744 per year for those aged 65–74 in 1971 and $671 for those aged 75–84).

Table 4, using multivariate analysis, suggests that the most important factors distinguishing those who successfully aged from all others interviewed in 1971, apart from age, were: bad outcomes occurring to a spouse, self-reported health in 1971, retirement because of poor health, not developing cancer or diabetes, and not having good mental status. Females were no more likely to age successfully than were males.

Factors which distinguish those who successfully aged from those who survived to 1983 but were functionally dependent are shown in Table 5. After controlling for age, self-rated health was again a strong predictor of successful aging. Individuals who did not have diabetes were also more likely to age successfully, although cancer had no similar impact. The odds of successful aging were decreased if one's spouse died or was assessed for or placed in a nursing home.

Discussion

Successful aging has been defined in terms of an individual retaining the ability to function independently.[1,2] Those who age successfully remain out of institutions and do not have continuing input from a

TABLE 4—Adjusted Relative Odds of Successful Aging as Estimated by the Multiple Logistic Regression Model. I. Comparing Those Who Age Successfully with Those Who Died or Became Functionally Dependent by 1983

	Relative Odds Estimate	95% Confidence Interval
Age of Individual in 1971		
65–69/80–84	28.8	(13.9, 59.7)
70–74/80–84	12.7	(6.1, 26.3)
75–79/80–84	4.5	(2.1, 9.7)
Sex		
female/male	1.2	(1.0, 1.5)
Spouse Assessed/Placed in Nursing Home (1971–82)		
yes/others	0.2	(0.1, 0.5)
Spouse Died 1971–82		
yes/others	0.4	(0.2, 0.6)
Self-Rated Health 1971		
excellent/poor bad	7.0	(4.0, 12.4)
good/poor bad	4.0	(2.4, 6.8)
fair/poor bad	2.4	(1.4, 4.2)
Reason for Retiring (1971)		
poor health, compulsory/others	0.6	(0.5, 0.8)
Cancer (1970–82)		
no/yes	3.5	(2.4, 5.1)
Had Physician Visit(s) for Diabetes (1970–82)		
no/yes	1.7	(1.3, 2.5)
Interviewer Assessed State of Mind (1971)		
steady and strong/else	2.5	(1.4, 4.6)
Score on Mental Status Index (1971)		
High score (9 or 10)/Lower score (0–8)	1.6	(1.1, 2.4)

Model Chi-Square = 514 with 15df. Region of residence was included in the model to control for sampling fraction. Logistic regression results were based on comparing 583 individuals who aged successfully with 2,350 individuals who died or became functionally dependent by 1983. The score on the mental status index, not having diabetes, and rating one's health as fair, reached the 0.05 level of significance in only one of the split half models and the final model.

home health agency. They remain mobile and competent in all the activities of daily living. While these individuals defined their health status in 1983 as fair or better, we deliberately did not label these individuals the "healthy aged." Healthy implies the absence of disease and further, individuals with the "same disease" may have a different sense of well-being and ability to function.[12]

Our results are interesting not only because of the variables they include, but also for the variables which they do not include. None of the measures of socioeconomic status were significant in the final models, even though the measures available in 1971 were extensive. Also, an index combining high scores on the education, occupation and income variables was constructed but did not prove significant.

Two recent studies[13,14] have reported that low incomes are associated with poor health outcomes for Canadians despite universally insured medical and hospital care. Guralnik and Kaplan[12] also found income predictive of a high level of functioning in the 19-year follow-up of Alameda County residents. Two factors may help to account for our contradictory findings compared to these earlier studies. The income effect may decrease with age because: not as many poor people as others survive long enough to be classified as "old"; the income gradient among the elderly may narrow with government transfer payments improving the lot of the poor, while advancing age is depleting the resources of the wealthy. Haan, *et al*,[15] compared age-specific mortality rates among White Alameda County residents of poverty and non-poverty areas. While in the younger age groups the mortality rates in poverty areas were much higher, among those ages 65 and older, there was essentially no difference. Finally, the one group in Canadian society which is most economically disadvantaged, Native Canadians, were excluded from the analysis.

This study presents strong evidence that regular contact with physicians, even among elderly individuals (one of the highest risk groups in the population), is not related to successful aging. Regular contact with the health care system was measured with a high degree of accuracy. Neither the percentage of years in which individuals made one or more visits, nor the percentage of years in which two or more visits were made, was associated with successful aging.

Many measures of disease and functional status were not useful predictors of successful aging. None of the measures of poor functional status in 1971, including indicators that an individual needed help in the activities of daily living or in instrumental activities, none of the self-reported health conditions (including stroke, arthritis, etc.) and only one of the conditions for which physician visit data were available (diabetes) was negatively associated with successful aging.

These findings are contrary to most preconceptions and to some literature. The National Institute of Mental Health's Human Aging II Study,[16] a longitudinal follow-up of a small number of very healthy males, found even asymptomatic disease was negatively predictive of longevity. However, that study focused on longevity alone and longevity is only one (albeit an important) aspect of successful aging.

Having cancer was negatively associated with successful aging but primarily influenced longevity; people with cancer were less likely to live long enough to age successfully by our criteria. However, if such individuals did survive to 1983 (6.7 percent of those surviving to 1983 had cancer), they were just as likely to have aged successfully as those without cancer.

Since age is strongly related to mortality, odds ratios for categories associated with successful aging are greater for the model whose comparison group included decedents (Table 4). The magnitude of the odds ratio for the female sex decreased somewhat from model one to model two (Table 5) reflecting the fact that, although more females may survive, their chance of aging successfully appears to be lower than that for males who survive.[17] A comparison of self-rated health in the two models suggests the distribution of self-rated health in 1971 among those who subsequently died was similar to that among those who remained alive but dependent.

Previous work in Manitoba demonstrated that self-rated health was a predictor of mortality over a six-year period independent of objective health status[18] and this relationship has been confirmed by

TABLE 5—Adjusted Relative Odds of Successful Aging as Estimated by the Multiple Logistic Regression Model. II. Comparing Those Who Age Successfully with Those Who Were Alive in 1983 but Dependent

Specification of Variable	Relative Odds Estimate	95% Confidence Interval
Age of Individual in 1971		
65–69/80–84	11.5	(5.3, 25.0)
70–74/80–84	5.6	(2.6, 12.3)
75–79/80–84	2.7	(1.2, 6.2)
Sex		
female/male	0.8	(0.6, 1.0)
Spouse Assessed/Placed in Nursing Home (1971–82)		
yes/others	0.1	(0, 0.4)
Spouse Died 1971–82		
yes/others	0.4	(0.3, 0.8)
Self-Rated Health 1971		
excellent/poor bad	5.5	(2.9, 10.6)
good/poor bad	3.0	(1.7, 5.5)
fair/poor bad	2.2	(1.2, 4.0)
Reason for Retiring (1971)		
poor health, compulsory/others	0.7	(0.5, 0.9)
Cancer (1970–82)		
no/yes	1.0	(0.6, 1.7)
Had Physician Visit(s) for Diabetes (1970–82)		
no/yes	1.5	(1.0, 2.2)
Interviewer Assessed State of Mind (1971)		
steady and strong/else	1.9	(1.0, 3.9)
Score on Mental Status Index (1971)		
High score (9 or 10)/Lower score (0–8)	1.9	(1.2, 2.8)

Model Chi-Square = 208 with 15df. Included in the model was region of residence to control for sampling fraction. Logistic regression results based on comparing 583 individuals who aged successfully with 662 individuals who were alive in 1983 but dependent. Age 75–79, having a spouse who died, retiring because of poor health, having a visit for diabetes, reporting fair health and having a high score on the mental status index, reached the 0.05 level of significance in only one of the split half models and the final model.

others.[19] The present study extends these findings by demonstrating that self-rated health is not only an important predictor of mortality over the longer 12-year period, but is also one of the few factors associated with successful aging among those who survive. Muller[20] suggested that the predictive contribution of self-rated health could be partly due to Mossey and Shapiro's including indicators developed from utilization data in their measure of objective health status. She suggested pessimism and depression might be the actual causal factors. Although measures of life satisfaction in 1971 were predictive of successful aging in early models, they made no contribution here to the final models which included the self-rated health measure.

There were measures unavailable to this project which might have made useful contributions. The most obvious limitation of the data was the lack of biological measures of function (blood pressure, etc.) and the lack of measures of health practices (smoking history, alcohol consumption, regular physical activity, etc. although the latter could be approximated by the questions pertaining to leisure time activities). The Alameda County study found individuals with more low risk practices to have lower mortality rates.[21] The Framingham Study, after 21 years of biennial observations, also reported that alcohol intake, smoking, ventricular rate, and education were related to good functioning status for men although, for women, the only significant predictor other than age was education.[22]

In conclusion, a significant group of elderly do age successfully. These individuals express more satisfaction with their lives and incur substantially fewer health expenditures than other elderly. Individuals at particular risk of not aging successfully include those with poor self-assessed health, whose spouse has died, whose mental status is somewhat compromised, who developed cancer, and those who are forced to retire or retire because of poor health. ☐

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APPENDIX

Variables Available to the Analysis
(All Items from 1971 Interview Except as Indicated)

- **Ethnicity and Cultural Characteristics of Individual**
  - National descent
  - Language spoken
  - Date of arrival in Canada
  - Language of interview

- **Socioeconomic Characteristics of Individual**
  - Level of education attainment (number of years or grades completed in school)
  - Major occupation when employed
  - Current employment in major or other occupation
  - Major reason for continuing working (if applicable)
  - Total monthly income (a total of income reported from three sources: own resources—wage, rents, interest, etc.; pensions or allowances; other sources—children, etc.)
  - Disposable income (calculated by subtracting monthly expenses from monthly income)
  - Percent of income from private sources
  - Whether income satisfied current needs
  - Whether income would satisfy future needs
  - Would extra income be spent on food, medical needs, etc.
  - Ownership of current residence
  - Characteristics of residence
    - Heating satisfactory, lighting satisfactory, complete bathroom available, bathroom sharing, a room of one's own?
    - Residence in a senior citizens' housing unit

- **Characteristics of Individual's Social Network**
  - Marital status
  - Living arrangements (with spouse, with spouse and others, other)
  - Number of relatives, amount of contact with them and "nearness"
  - Frequency of contact with neighbors, friends
  - Death of spouse between 1971 interview or person's death or December 31, 1982*
  - Spouse assessed for or entered nursing home during same period*

- **Individual's Mental Status**
  - Score on 10 question mental status test[23]
  - Frequency of forgetting names of friends or relatives, time of day. How quickly recalled?
  - Interviewer's assessment of respondent's:
    - —state of mind (steady and strong to weak or unsteady)
    - —attitude (friendly to hostile)
    - —comprehension of questions (satisfactory to unsatisfactory)

- **Satisfaction with Life**
  - In general
  - Score on 20 question Life Satisfaction Index "A"[24]

- **Individual's Health Status**
  - Self-reported health: "For your age, would you say your health is excellent, good, fair, poor or bad?"
  - Reporting any of 15 health problems including diabetes, chest problems such as asthma or emphysema
  - Under treatment for any of these conditions
  - Amount of time in bed at home because of illness in last year: none, less than one week, one week to a month, more than a month
  - Help required in basic activities of daily living (getting in and out of bed, dressing, bathing, eating, using stairs)
  - Number of activities requiring help from someone outside the house (light housework, making tea, preparing a hot meal, shopping, laundry, heavy housework, financial affairs)
  - Number of activities requiring help from someone inside or outside the house (nursing care, cutting toenails, going out of doors, watching TV or reading)
  - Required attention of physician or nurse when last sick
  - Moved because of ill health
  - Retired because of poor health
  - Living in a senior citizen housing unit (individuals tend to move to these rental units when they have difficulty maintaining themselves at home usually for health and/or economic reasons)
  - Unmet health care needs for eyeglasses, hearing aid, false teeth, cane, special shoes, wheelchair or medicine
  - Mean number of physician visits (per year alive) for conditions identified as increasing an individual's "risk of not recovering from an illness"[10] e.g. angina, arthritis, arrhythmia, diabetes, hypertension over period 1970–82*
  - Number of above listed conditions for which made one or more physician visits (per year alive); for which made two or more physician visits (per year alive)*
  - Cancer (excluding skin cancer) diagnosed 1970–82**

- **Participation in Leisure Time Activities**
  - 21 alternatives including visiting, telephoning, listening to radio or TV, work, etc.
  - Which activities are most important

- **Access to Care**
  - Difficulty getting to see a doctor/dentist because of transportation, language problems or distance
  - Percentage of years alive in which one or more visits to physician were made; in which made two or more visits, 1970–82*

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*Indicator derived from claims files of Manitoba Health Services Commission.
**Indicator derived from files of the Manitoba Cancer Registry.

Does Maternal Tobacco Smoking Modify the Effect of Alcohol on Fetal Growth?

ABSTRACT

Smoking and drinking habits were registered by a self-administered questionnaire in 36th week of gestation in 11,698 pregnant women, more than 80 percent of all such women in two Danish cities 1984–87. Alcohol consumption of 120 g/week or more was associated with a greater reduction in the average birthweight in the babies of smokers than of non-smokers (about 40 grams for the non-smokers and about 200 grams for the smokers). This is particularly striking considering that the average birthweight for smokers is lower than for non-smokers. A birthweight difference of more than 500 grams was found between babies of mothers who neither smoked nor drank and mothers who smoked and drank heavily. Our data suggest that women's smoking habits should be taken into consideration when giving pregnant women advice about drinking. (*Am J Public Health* 1991; 81:69–73)

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Introduction

It has been known for many years that smoking during pregnancy reduces fetal growth[1] and it is also well established that growth retardation is part of the fetal alcohol syndrome.[2] Tobacco smoking relates to fetal growth and birthweight in a dose-response manner[1] but the association with alcohol consumption remains less clear. In a recent publication,[3] only alcohol intake of 120 grams or more per week was associated with low birthweight, and it was suggested that health education should be directed mainly toward mothers who drink 100 grams of alcohol or more per week. Another recent study[4] found that alcohol had an effect on birthweight only in smokers.

The purpose of our study was to investigate whether it is reasonable to assume a threshold for the effect of alcohol on birthweight and other growth parameters according to smoking habits.

Methods

Detailed information was collected on drinking and smoking habits of pregnant women attending the midwife centers in Odense and Aalborg, Denmark during their 36th week of gestation, from April 1984 to April 1987. The mothers sent a completed questionnaire directly to the Department of Social Medicine, Odense University. The medical records and questionnaires were given a study number which was not related to the personal identification number. After delivery, obstetrical information was extracted from the medical records and linked to the questionnaire data by means of the study number.

More than 95 percent of all pregnant women in two defined geographical areas at the 36th week of gestation were covered, for a total of 13,815 women. After excluding multiple births, data were available from the questionnaires and medical files for 11,850 women. Most of the non-responders failed to answer reminders, and some left the study area before delivery so that no data were available regarding the child. Also excluded were 152 women who gave birth before the 36th week of gestation; the data file thus consisted of 11,698 women.

Detailed questions were asked concerning beer, wine, spirit, coffee, and tea consumption before and during pregnancy. The number of alcoholic drinks per week was calculated; each drink was considered to contain 12 grams of absolute alcohol according to normal quantities of alcoholic beverages per glass (or bottle of beer) in Denmark. The data on smoking and drinking were self-reported and referred to average consumption during the first 36 weeks of gestation.

Data on gestational age, weight increase during pregnancy, placental weight and measurements of the child (weight, length and head circumference) were recorded from the mothers' and infants' hospital records. All were measured blind to knowledge of questionnaire data. All deliveries took place at one central hospital in each region. The midwives who car-

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ried out the recording had a comparable training and conducted the assessments in a standardized way. The study was part of a large community trial among pregnant women in Denmark.[5]

In the data analysis, multiplicative as well as additive models have been used (logistic regression and analysis of variance). The variables which were most closely associated with alcohol consumption and which were known to be predictors of fetal growth were included as confounders.

Results

Table 1 displays the characteristics of the participating women. Smoking and drinking habits during the first 36 weeks of gestation are shown in Table 2. Thirty-five percent were non-smokers who drank 1–29 grams of alcohol per week. Almost 200 women reported that they consumed 120 grams (10 drinks) or more per week and 832 indicated a smoking history of 15 cigarettes or more per day. The proportion of newborns with a birthweight of less than 2500 grams varied widely with a tendency to correlate with the frequency of alcohol and tobacco use.

Most newborn measures decrease with increasing cigarette and alcohol intake. Among smokers the decrease associated with alcohol is greater than among non-smokers (see Table 3).

In Table 4, the results of the analysis of variance of the data shown in Table 3 are presented. Among non-smokers, alcohol consumption was found to be statistically significantly associated with placental weight and birthweight (test for trend). Among smokers of 1–9 cigarettes, alcohol was associated with birth length, and in the subgroup of heavy smokers alcohol was significantly associated with all measures (except birth length).

All of the variables in Table 4 depended upon the duration of pregnancy and in two additional analyses of variance, confounding by gestational age was addressed (data not shown). In one model, gestational age was included as a covariate and, in another model, the analyses were restricted to women who gave birth between the 39th and 41st weeks of gestation. In these analyses, the adjusted differences from the mean were in the same direction but usually a little smaller. A statistically significant association between alcohol consumption and placental weight was still found for non-smokers. In the group of moderate smokers, significant associations were found for placental weight, birthweight and birth length (but not in the restricted analyses). In the group of heavy smokers, all associations remained statistically significant at the 0.05 level (except in the restricted model with birth length).

Clear "dose-response" relationships were not seen in any models in Table 4, except for birthweight among heavy smokers. However, random variation due to small numbers in the sub strata should be taken into consideration. Among heavy smokers, women who drank more than 30 grams of alcohol per week had a substantially lower birthweight. This is particularly striking considering the generally low mean for that group of women.

Table 5 presents odds ratios for low birthweight according to alcohol consumption compared with frequency of low birthweight for non-drinkers. Each smoking stratum represents a separate analysis. A two- to three-fold increase was seen for all consumers of 120 grams of alcohol or more per week. The marginal values in the table show an excess risk of low birthweight in the group of "heavy drinkers" only. The prevalence of low birthweight increased steadily with increasing cigarette consumption, as can be seen in the right hand column.

All analyses in Table 5 were repeated with the subset of women who gave birth in the 39th–41st weeks of gestation and weight increase during pregnancy was also included in the models. By restricting analyses to deliveries at term, a four-fold increase of low birthweight was found for consumers of more than 120 grams of alcohol per week (data not shown).

After controlling for average alcohol consumption, no association between binge drinking and any of the pregnancy outcome measures was seen (data not shown).

TABLE 1—Age, Parity, Gestational Age at Birth and Weight Increase during Pregnancy for 11,698 Participating Women

Characteristics	N. Cases	%
Age (years)		
under 24	3,473	29.7
25 to 34	7,356	62.9
35 or more	869	7.4
Parity		
0	5,628	48.1
1	4,412	37.7
2 or more	1,658	14.2
Gestational age in weeks		
under 39	1,890	16.2
39 to 40	6,122	52.3
41 or more	3,686	31.5
Weight increase in kg*		
under 11	2,923	34.4
12 to 15	2,970	35.0
16 or more	2,599	30.6

*3,206 missing from start of pregnancy to the time of delivery

According to the present data set, neither the additive nor the multiplicative model of interaction between alcohol consumption and tobacco smoking on any of these measured outcomes fitted the data very well, despite the fact that both models were acceptable according to formal statistical testing of interaction terms.

Discussion

Birthweight was closely correlated with the combined exposure to alcohol as

TABLE 2—Number of Pregnancies According to Maternal Drinking and Smoking Habits: Bottom line, Newborns < 2500 g in percent

Number of Cigarettes per Day	Grams of Alcohol per Week						
	0	1–	30–	60–	90–	120+	All
0	1,267	4,088	1,082	404	103	101	7,045
	2.0	1.6	1.8	1.5	1.0	4.0	
1–4	102	368	110	55	10	15	660
	2.9	3.5	2.7	3.6	0.0	13.3	
5–9	294	839	213	74	26	28	1,474
	5.1	4.2	2.8	1.4	0.0	10.7	
10–14	315	894	218	70	31	24	1,552
	4.1	4.8	7.2	5.7	9.7	0.0	
15+	172	433	132	40	26	29	832
	3.5	6.2	5.3	7.5	11.5	25.0	
All	2,150	6,622	1,755	643	196	197	11,563*

*135 missing cases

TABLE 3—Means of Placental Weight, Birthweight, Birth Length and Head Circumference According to the Mother's Alcohol Consumption during Pregnancy, Stratified by Smoking Status

Smoking Status (Daily)	Alcohol in g/Week	Placental Weight in g	Birthweight in g	Birth Length in cm	Head Circumference in cm
Non-smokers	0	569	3,572	52.6	35.4
	1–	561	3,579	52.6	35.4
	30–	557	3,602	52.8	35.5
	60–	537	3,582	52.6	35.5
	90–	532	3,554	52.8	35.4
	120+	534	3,536	52.4	35.5
Subtotal	Mean	560	3,580	52.6	35.4
	(Stddev)	(132)	(483)	(2.3)	(1.5)
1–4 cigarettes	0	567	3,487	52.2	35.1
	1–	557	3,493	52.3	35.3
	30–	572	3,479	52.0	35.4
	60–	564	3,573	52.6	35.3
	90–	626	3,727	53.4	35.6
	120+	450	3,141	51.3	34.7
Subtotal	Mean	560	3,492	52.2	35.3
	(Stddev)	(135)	(510)	(2.5)	(1.6)
5–9 cigarettes	0	555	3,330	51.6	35.0
	1–	548	3,321	51.5	35.0
	30–	528	3,261	51.5	34.9
	60–	522	3,379	51.9	34.8
	90–	524	3,444	52.1	35.5
	120+	489	3,144	50.6	34.6
Subtotal	Mean	544	3,316	51.5	35.0
	(Stddev)	(121)	(458)	(2.2)	(1.6)
10–14 cigarettes	0	572	3,357	51.5	35.0
	1–	548	3,282	51.4	34.9
	30–	535	3,259	51.4	34.8
	60–	528	3,291	51.4	34.7
	90–	540	3,123	50.5	34.4
	120+	493	3,116	50.9	34.4
Subtotal	Mean	549	3,289	51.4	34.9
	(Stddev)	(132)	(467)	(2.2)	(1.5)
15+ cigarettes	0	546	3,270	51.4	34.9
	1–	561	3,266	51.3	34.8
	30–	531	3,207	51.3	34.6
	60–	524	3,123	50.8	34.6
	90–	539	3,169	50.8	34.8
	120+	472	3,023	50.8	34.0
Subtotal	Mean	548	3,239	51.2	34.7
	(Stddev)	(128)	(459)	(2.3)	(1.5)
Total	Mean	556	3,478	52.2	35.2
	(Stddev)	(132)	(497)	(2.4)	(1.6)

well as smoking, but a number of limitations of the study should be kept in mind. The sample was truncated at 36 weeks, and therefore precluded study of babies born at earlier gestation. Since data on smoking and drinking habits are self-reported, intake of alcohol especially was likely to be underreported, particularly high consumption levels. For this reason, no estimates were made for alcohol consumption of more than 120 grams per week. Few women indicated no drinking at all during pregnancy, which agrees with our impression that Danish women usually report moderate and socially acceptable levels of drinking without hesitation.

It is likely that the heavy drinkers were more prevalent among non-responders than responders, but since exposure data were collected prior to the deliveries, bias is not a serious problem. Nevertheless, the effects shown may be underestimates.

Sulaiman, *et al*,[3] suggested that health education during pregnancy should be directed toward mothers who drink more than 100 grams of alcohol per week since no statistically significant effect was seen below this level. However, that study was rather small with only a few women consuming more than 100 g absolute alcohol per week. Lumley, *et al*,[6] did not detect any harmful effect on fetal outcome of alcohol consumption during pregnancy at levels below two glasses a day. Our data indicate that health education should take smoking habits into consideration when giving advice about alcohol use during pregnancy. If pregnant women do not give up smoking while pregnant, a much lower level of alcohol intake should be aimed at. Furthermore, it must be taken into consideration that only a limited set of potential adverse effects of alcohol or smoking combined have been studied. Martin, *et al*,[7] found that maternal alcohol intake, coupled with smoking, exerted an interactive and deleterious effect upon newborn learning.

Our data to some extent supported the findings that consumption of beer is more closely related to adverse outcomes of pregnancy,[3,9,10] but it is likely that the association was confounded by social factors not recorded in the study (data not shown). We cannot recommend that health education should address the types of beverages differently at present.

We found that the average consumption of alcohol was much more important than binge drinking (data not shown). However, this may not be true for other adverse outcomes of pregnancy. Keeping alcohol's teratogenic effect in mind,[2] it is still wise to warn against binge drinking while pregnant.

Kariniemi, *et al*,[11] found that maternal alcohol consumption only decreased the birthweight among female fetuses. However, no such effect was seen in our study (data not shown).

Low birthweight remains the most important determinant of perinatal mortality and impaired development. When alcohol consumption increases among women, one should be aware of the fact that combined exposure of both alcohol and tobacco may reduce birthweight to a substantial degree, as illustrated by the increased ORs of low birthweight. The difference in birthweight between the lowest level of alcohol and tobacco use and the highest levels was found to be more than 500 grams.

In a large scale study, Mills, *et al*,[12] found somewhat different effects than we did. In our data, heavy alcohol consumption seemed to have a stronger effect on birthweight among smokers than non-smokers, whereas this phenomenon was apparently absent in Mills' data. Like

TABLE 4—Adjusted Differences from Mean Values of Placental Weight, Birthweight, Birth Length and Head Circumferences According to the Mother's Alcohol Consumption during Pregnancy, Stratified by Smoking Status: Analysis of Variance*

Smoking Status (Daily)	Alcohol in g/Week	Placental Weight in g	Birth-weight in g	Birth Length in cm	Head circumference in cm
Non-smokers	0	9	1	−.0	−.0
	1−	2	−2	−.0	−.1
	30−	−1	21	.1	.1
	60−	−29	−14	−.1	.0
	90−	−34	−48	.0	−.1
	120+	−35	−44	−.2	.0
	Mean	565	3,582	52.6	35.4
1–9 cigarettes	0	12	24	.1	.0
	1−	2	1	−.0	.0
	30−	−9	−45	−.1	−.0
	60−	−9	72	.4	−.1
	90−	−3	121	.5	.4
	120+	−65	−245	−1	−.5
	Mean	554	3,377	51.7	35.1
10+ cigarettes	0	13	63	.1	−.0
	1−	5	−9	−.0	.1
	30−	−19	−61	.1	−.2
	60−	−22	−31	−.1	−.1
	90−	−6	−145	.0	−.9
	120+	−73	−206	−.2	−.7
	Mean	554	3,283	51.3	35.4

*All values have been adjusted for parity (0, 1, 2, +), school education (−9y, 10y, 11 + y) and age. Multiple classification analysis, adjusted for main effects and covariates in 3 separate subgroups according to smoking habits.

TABLE 5—ORs (and 95% CI) of Low Birthweight (< 2,500 g) According to the Mother's Smoking and Drinking Habits during Pregnancy (logistic regression)

Smoking* Status (Daily)	Alcohol in g/Week						Adjusted for Alcohol
	0	1−	30−	60−	90−	120+	All
0	1.0	0.8 (0.5–1.3)	0.9 (0.5–1.6)	0.8 (0.3–1.9)	0.5 (0.1–3.8)	2.2 (0.7–6.5)	1.0
1–9 cigarettes	1.0	0.9 (0.5–1.6)	0.6 (0.3–1.4)	0.5 (0.1–1.7)	— —	2.7 (0.9–8.0)	2.2 (1.7–3.0)
10+ cigarettes	1.0	0.8 (0.5–1.3)	0.6 (0.3–1.1)	0.9 (0.4–2.2)	1.6 (0.6–4.1)	2.1 (0.8–5.2)	3.4 (2.6–4.3)
Adjusted for smoking All	1.0	1.0 (0.7–1.3)	1.0 (0.7–1.5)	0.9 (0.5–1.5)	1.1 (0.5–2.5)	2.7 (1.5–4.8)	

*Logistic regression made on those subgroups of women according to smoking habits and on all in the study (marginal row and column) all analyses adjusted for age, school education, and parity. Alcohol and smoking entered the model as "dummy variables."

Mills, *et al*, we found little effect of low to moderate drinking among non-smokers but among heavy smokers reductions in average birthweight tended to appear already at an alcohol consumption of 30–59 g/week, and this pattern was not evident from the Mills data. One problem of comparing the two studies is that they did not use the same standards for alcohol and smoking exposure. More important, however, is the fact that our exposure data were collected at the 36th week of gestation while Mills' data were collected at the first visit in the first trimester. The generally stronger effects of alcohol on birthweight seen in our study may thus reflect the impact of a more relevant time period.

Although the significance of placental weight is disputed, it has been found to be a predictor of growth later in the childhood.[13] It is therefore interesting that alcohol consumption was found to be associated with relatively large reductions in average placental weight, although it should be kept in mind that the effects might have been exerted via fetal growth since birthweight and placental weight are closely associated.

Unfortunately, only some of the potential confounders could be controlled in this study. Nutrition, in particular, may be an important confounder in a study of alcohol consumption and fetal growth. Furthermore, it is likely that heavy drinkers may be less willing to follow prenatal care. Use of other drugs may be a confounder in some countries but it is unlikely in this sample.

The combined effect of alcohol and tobacco smoking should be taken into consideration when advising on health behavior during pregnancy. □

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Pew Commission Advances Agenda Action for Nation's Health Professional Schools

The Pew Health Professions Commission met for the second time on November 7 and 8 in Washington, DC to advance 18 reform recommendations as part of a national Agenda for Action that addresses health care and educational issues challenging the nation's health professional schools. This agenda is built on an analysis of the current health care environment and the major forces and trends which will shape health care in the United States over the next 15 years.

The Commission's recommendations for discussion include a redefinition of the core science curriculum; a reorientation of the teacher-learning process; a shift in patient care training setting; a dissolution of the boundaries between the health professions; a redirection of faculty incentives; the creation of new governance and organizational arrangements; and a change in the orientation of the health professions from illness to health.

The Pew Commission will continue to refine the Agenda for Action over the next three months, and is expected to announces its final Agenda for Action in April 1991. The five objectives of the Pew Commission are to: establish a national Agenda for Action; develop appropriate policy recommendations for federal, state, professional and institutional agencies which will support implementation of the Agenda for Action; communicate the Agenda for Action; provide institutional change resources; and explore and fund demonstration projects at health professional schools across the nation.

The Pew Health Professions Commission is an outgrowth of the Future of the Health Professions project, a program of Duke University and The Pew Charitable Trusts. Over the past six years, The Pew Charitable Trusts has invested over $60 million of programming support in its Strengthening the Health Professions initiative and has secured an additional $40 million of leveraged support from other foundations for this initiative. For further information, contact Pew Health Professions Commission, Duke University Medical Center, 3101 Petty Road Suite 1106, Durham, NC 27707. Tel: (919) 490-6695; Fax (919) 489-5907.

Admission and Mid-Stay MedisGroups® Scores as Predictors of Death Within 30 Days of Hospital Admission

ABSTRACT

We examined the ability of MedisGroups, a severity measure based on clinical data abstracted from the medical record, to predict mortality 30 days following admission. MedisGroups measures severity both on admission and approximately one week into the hospital stay. The data base was a random sample of 20,985 admissions of Medicare beneficiaries with one of six conditions from 833 hospitals in seven states between January 1985 and May 1986. In all six conditions, higher admission and mid-stay severity scores were generally associated with higher risk of death. Across the six conditions, the R-squared values for predicting death using admission scores ranged from 0.01 to 0.16; R-squared values using mid-stay scores ranged from 0.03 to 0.34; and R-squared values from combining admission and mid-stay scores ranged from 0.05 to 0.41. Admission MedisGroups score was thus only modestly predictive of 30-day mortality. While the mid-stay score was more powerful, it may not be an appropriate severity adjuster to screen for quality using hospital mortality rates because it could be influenced by substandard care. (*Am J Public Health* 1991; 81:74–78)

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Introduction

The Federal Government annually publishes mortality rates of almost 6,000 United States hospitals caring for Medicare beneficiaries. Although release of the mortality data is accompanied by numerous and appropriate disclaimers about their utility, the data are clearly intended to serve as an initial clue about the quality of hospital care, especially in an era of tightening cost constraints. The first hospital mortality statistics, published in March 1986, indicated that 142 hospitals had significantly higher death rates than predicted and 127 had significantly lower rates.[1] However, the facility with the most aberrant death rate (87.6 percent of Medicare patients dying compared with a predicted 22.5 percent) was a hospice caring for terminally ill patients. The government model had not adequately considered severity of illness.

This incident prompted a flurry of research activity, which has resulted in more sophisticated and methodologically sound approaches for producing the Medicare hospital mortality statistics.[2] Since 1987, the model has adjusted for patient age, secondary diagnoses, and a variety of other characteristics available in Medicare's administrative files; in addition, to control better for case mix and to accommodate the possibility that hospitals may perform better in some clinical areas than in others, condition-specific hospital mortality rates are also produced for selected diseases. However, data limitations remain. The information contained in Medicare's administrative files is confined to basic demographic, diagnostic, and procedural data not considered adequate to the task of severity adjustment by some critics.[3–7] The purpose of this research was to examine the performance of MedisGroups®, a severity measurement system based on data drawn from the medical record, as a predictor of mortality.

Methods

Description of MedisGroups

MedisGroups assesses severity as the risk of imminent organ failure independent of diagnosis, using information on key clinical findings (KCFs) abstracted from the medical record. MedisGroups is a registered trade name; the system is owned and marketed by MediQual Systems, Inc., in Westborough, Massachusetts. Severity is scored on admission on a five-point scale ranging from 0 to 4. For patients who remain hospitalized for the required period, a second severity rating is performed, the so-called "mid-stay" review, generating an appraisal of extent of "morbidity" (no morbidity, morbid, or major morbidity). MedisGroups is described in detail elsewhere,[8–11] and more information on the system is presented in an appendix. This description and the data used for this study pertain to the 1987 version of MedisGroups.

Address reprint requests to Lisa I. Iezzoni, Division of General Medicine and Primary Care, Department of Medicine, Beth Israel Hospital, 330 Brookline Avenue, Boston, MA 02215, Tel: (617)735-4476. Dr. Iezzoni is also responsible for negotiations concerning this manuscript. All the authors were with the Health Care Research Unit, Section of General Internal Medicine, Evans Memorial Department of Clinical Research and Medicine, Boston University School of Medicine. Dr. Iezzoni was also with the Health Policy Institute, Boston University School of Public Health. This paper, submitted to the Journal January 10, 1990, was revised and accepted for publication June 12, 1990.

TABLE 1—Number of Cases by Admission MedisGroups Score and Percent Dying within 30 Days by Condition

Condition	Admission MedisGroups Score 0	1	2	3	4	Total
	Number of cases (percent dying within 30 days)					
Pneumonia or COPD	73 (1.4)	656 (2.9)	1,985 (9.0)	798 (28.7)	40 (67.5)	3,552 (12.8)
Coronary revascularization	1,073 (2.5)	1,228 (4.7)	782 (6.9)	273 (19.1)	11 (36.4)	3,367 (5.8)
Acute myocardial infarction	159 (6.3)	536 (8.2)	1,516 (15.4)	974 (40.9)	127 (80.3)	3,312 (23.8)
Congestive heart failure	119 (5.9)	396 (7.6)	1,792 (10.3)	1,143 (23.0)	74 (55.4)	3,524 (14.9)
Cholecystectomy	1,002 (1.2)	1,094 (1.4)	1,192 (2.8)	298 (5.4)	3 (33.3)	3,589 (2.2)
Prostate surgery	1,258 (0.6)	1,769 (0.8)	557 (2.5)	56 (7.1)	1 (0.0)	3,641 (1.1)

When MedisGroups is used for quality assessment, one strategy is to contrast the admission and mid-stay scores to determine whether the patient worsened, improved, or remained the same. For this purpose, admission scores of 0 and 1 are equated with no morbidity on the mid-stay review, while a 2 corresponds to morbid, and 3 and 4 correspond to major morbidity. In our analyses, we examined the predictive power of the admission MedisGroups score alone, the mid-stay review score alone, and the admission and mid-stay review scores considered together.

Description of the Data Base

The data base used for this study was created through the Health Care Financing Administration (HCFA) Health Standards and Quality Bureau. The data were collected by the peer review organizations (PROs) in Alabama, Arizona, Indiana, New York, Pennsylvania, Utah, and Wisconsin; the states were chosen to provide a geographically representative sample. Cases were randomly selected using administrative data on all Medicare beneficiaries, including disabled individuals younger than 65 years of age, admitted between January 1985 and May 1986. Selection was predicated on the presence of specified diagnostic and procedural codes. Final case selection was dictated by the PROs based on such factors as the availability of medical records. The analytic data base included 20,985 cases from 833 acute care hospitals across the seven states. The number of cases per hospital ranged from one to 480, with a median of 13 cases (mean = 25, standard deviation = 39) per hospital.

Conditions were selected based on their volume, relevance to Medicare beneficiaries (such as the elderly), and complexity of clinical issues raised in their care. The six study conditions were pneumonia or chronic obstructive pulmonary disease (COPD); coronary artery revascularization (including coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty); acute myocardial infarction; congestive heart failure; cholecystectomy; and prostate surgery (including transurethral and open prostatectomies). Cases in three conditions (pneumonia/COPD, acute myocardial infarction, and congestive heart failure) were selected using the principal diagnosis, while selection in the remaining conditions was based on procedure codes. Because of this selection approach, it was possible for cases chosen by diagnosis codes to have had a major procedure as well.

MedisGroups information and other selected clinical variables were collected by PRO abstractors trained by MediQual Systems, Inc. MediQual requires that reviewers achieve 95 percent exact agreement for items abstracted from the medical record; however, we did not independently confirm the reliability of the data. Data entry was performed by the PROs, then transmitted to MediQual Systems, Inc., for creation of a data tape for HCFA. The tape included admission and mid-stay scores, as well as the values for all KCFs.

Definition of Mortality

The data included date of death information from the Social Security administrative files, making it possible to identify deaths that occurred following discharge. The analyses focused on death within 30 days of admission, regardless of whether the death occurred in hospital. The 30-day figure is currently used by HCFA in producing its annual hospital mortality statistics, and it minimizes concerns about how differences in discharge practices across institutions and regions influence in-hospital death information.[2]

Statistical Methods

All analyses were performed within each of the six conditions. Each of the three models used the MedisGroups scores as categories indicated by dummy variables: admission score, five categories (0, 1, 2, 3, and 4); mid-stay review score, four categories (no mid-stay review, no morbidity, morbid, and major morbidity); and the joint categorization by both the admission and mid-stay scores, 20 categories (the five admission score classes crossed with the four mid-stay score classes). Given that each of our models contained only dummy variables as predictors, ordinary least squares and logistic regression methods produced exactly the same predicted probability of dying for every case (i.e., the same fraction dying among all cases in the same category). We looked at both the R-squared values and the C statistic from a logistic regression[12,13] to examine the ability of the three models based on MedisGroups scores to explain differences in death within 30 days of admission. However, only the R-squared values are reported here since no substantive differences emerged from looking at the C statistic.[10]

Results

Death Rates across MedisGroups Scores

The fraction of patients dying within 30 days of admission varied by condition,

TABLE 2—Number of Cases by Mid-Stay Review Score and Percent Dying within 30 Days by Condition

Condition	No Mid-Stay Review	Mid-Stay Review Score: No Morbidity	Morbid	Major Morbidity	Total
	Number of cases (percent dying within 30 days)				
Pneumonia or COPD	214	2,327	655	356	3,552
	(38.3)	(5.5)	(13.4)	(43.8)	(12.8)
Coronary revascularization	102	1,837	988	440	3,367
	(31.4)	(2.5)	(3.8)	(18.0)	(5.8)
Acute myocardial infarction	412	1,386	1,044	470	3,312
	(72.8)	(6.4)	(12.8)	(56.2)	(23.8)
Congestive heart failure	249	1,735	1,127	413	3,524
	(34.1)	(6.8)	(12.8)	(43.3)	(14.9)
Cholecystectomy	202	2,581	632	174	3,589
	(0.0)	(1.2)	(3.6)	(14.4)	(2.2)
Prostate surgery	228	3,217	165	31	3,641
	(0.0)	(0.8)	(4.8)	(19.4)	(1.1)

TABLE 3—Variation in Probability of Death within 30 Days of Admission Explained (R-Squared) by Admission Score Alone, by Mid-Stay Score Alone, and by Admission Plus Mid-Stay Score, by Condition

Condition	Admission Score Alone	Mid-Stay Score Alone	Admission Plus Mid-Stay Score
Pneumonia or COPD	0.11	0.15	0.24
Coronary revascularization	0.04	0.08	0.16
Acute myocardial infarction	0.16	0.34	0.41
Congestive heart failure	0.06	0.12	0.18
Cholecystectomy	0.01	0.04	0.05
Prostate surgery	0.01	0.03	0.05

with the surgical conditions having lower death rates (1.1–5.8 percent) than the medical conditions (12.8–23.8 percent), (Table 1). The distribution of cases across admission severity scores also varied by condition. For example, only 6.1 percent of the surgical cases had high admission scores of 3 or 4, compared with 30.4 percent of the medical cases. Within all six conditions, higher admission scores were generally associated with higher death rates.

However, even among cases with identical admission scores, those in conditions with higher overall death rates generally had higher severity-score-specific death rates. For example, among the six conditions, prostate surgery cases had the lowest overall death rate (1.1 percent) while acute myocardial infarction cases had the highest (23.8 percent). Not only did prostatectomy contain far fewer cases with scores of 3 and 4 than did acute myocardial infarction (1.6 percent of cases compared with 33.2 percent), but also, within each of the five admission scores, the rate of dying was less than one-fifth as great for prostatectomy cases as for infarction cases.

The rates of death by mid-stay review score also varied widely across conditions (Table 2), as did the distribution of cases across mid-stay scores. Even with major morbidity, patients in the three surgical conditions were much less likely to die than their medical counterparts. Death rates rose somewhat between no morbidity and morbid, but the rates increased at least threefold between morbid and major morbidity.

Except in cholecystectomy and prostate surgery cases, many of the patients with no mid-stay review died. For instance, 72.8 percent of acute myocardial infarction patients without a mid-stay review died, as did 31.4 percent of coronary revascularization patients. Thus, the reason for the absence of a mid-stay review was often the early death of the patient. Nevertheless, most of the patients who died remained alive long enough to have a mid-stay review. In three conditions, the plurality of patients who died had major morbidity. In cholecystectomy and prostate surgery patients, the 1 percent death rate among the many cases with no morbidity represented more deaths than the over 14 percent death rates among the few cases with major morbidity. In contrast, 33.6 percent of acute myocardial infarction deaths occurred among patients with major morbidity, while 38.1 percent of deaths occurred among patients with no midstay review.

Explaining Variations in Rates of Death

When admission scores were used to predict 30-day mortality (Table 3), the R-squared values ranged from 0.01 in cholecystectomy and prostate surgery cases to 0.16 in acute myocardial infarction cases. In comparison, the mid-stay review score was a more powerful predictor of risk of death, with R-squared values ranging from a low of 0.03 for prostate surgery to a high of 0.34 for acute myocardial infarction. Combining information about the admission and mid-stay scores generally yielded much greater predictive power than did either score alone, producing the highest R-squared value in all conditions.

Given the large fraction of deaths among those without a mid-stay review, we looked at whether the fact of a mid-stay review alone was predictive of death. We regressed 30-day mortality on a dichotomous variable indicating the presence or absence of a mid-stay review. For acute myocardial infarction cases, the R-squared value produced was 0.19. For other conditions, however, the R-squared value was much smaller: 0.04 for pneumonia/COPD and coronary revascularization, 0.02 for congestive heart failure, and 0.00 for cholecystectomy and prostate surgery. Thus, in all conditions, the simple fact of a mid-stay review did not appear to cause the greater predictive power of the mid-stay review categories.

Discussion

The superior performance of the two approaches involving the mid-stay review was not primarily related to the fact that the absence of a mid-stay review identified patients who died quickly, except among acute myocardial infarction patients. Probably more important is the reliance of the mid-stay review score on physiological derangements generally one week into the hospitalization. It seems almost a clinical truism that patients with severe problems this far into the admission would have worse prognoses than patients without such findings. By contrast, however, admission scores include severe physiological derangements that can often be treated effectively with current medical therapeutics. This conjecture is consistent with the relatively weak performance of the admission MedisGroups score as a predictor of mortality.

In general, patients in the three surgical conditions were much less likely to die, despite high admission scores. The reason may be that those acute physiological derangements that present on admission (and are reflected in high admission scores) represent manifestations of the patients' underlying disease, which will be explicitly addressed by the surgery, usually with a successful outcome (especially for cholecystectomy and prostate surgery). In contrast, certain physiological derangements stemming from acute and chronic medical ailments may be less amenable to control and resolution.

This study has several limitations. First, the number of deaths was relatively small, especially for the surgical conditions. Thus, the R-squared values reported here (particularly for the combined admission and mid-stay score model) may be inflated by overfitting. Second, the results cannot be generalized to younger patients, although the case selection strategy included a small number of Medicare beneficiaries younger than 65 years of age. Finally, MedisGroups was developed to reflect events during a hospitalization. By focusing on death within 30 days of admission, we included some events that occurred following discharge. When analyses were repeated using in-hospital death, admission scores and mid-stay scores produced R-squared values virtually identical to those for 30-day mortality, except for acute myocardial infarction cases, for which the R-squared value for the mid-stay score was 0.39 for in-hospital death compared with 0.34 for 30-day mortality. Similarly, for the combination of admission and mid-stay scores the R-squared values were only 0.01 to 0.03 higher for predictions of in-hospital mortality, except in acute myocardial infarction cases, for which the R-squared value was 0.47 for in-hospital death compared with 0.41 for 30-day mortality.

Even if the mid-stay review score were perfectly predictive of mortality, it is not at all clear that it would be an appropriate risk adjuster for widespread quality assessment efforts, such as the federal hospital-level mortality figures. The mid-stay review rating could be affected by shortfalls in the quality of care, the very event that mortality statistics seek to identify. Therefore, adjusting mortality figures by the mid-stay review score could mask instances of quality problems.

For such risk adjustment, the appropriate construct is the admission "severity" score, which performs relatively poorly as a predictor of 30-day mortality in this data base. These findings could be contrasted with those produced by other models of admission severity, such as the Medicare Mortality Predictor System[14,15] and the Acute Physiology and Chronic Health Evaluation,[16-18] but such comparisons would be hampered by differences in the data bases, predictive models, and statistical techniques used in the different studies. No published research yet exists comparing the performance of various severity systems as predictors of 30-day mortality on comparable data bases across conditions.

Although these results must be viewed as preliminary and pertinent only to Medicare beneficiaries, they may have important implications for states and regions that have mandated the collection of severity information for assessing hospital quality, especially if one purpose is to examine severity-adjusted mortality rates. For example, Pennsylvania and Iowa now require hospitals to collect patient severity information using MedisGroups, with one goal being to examine severity-adjusted outcomes. Our findings raise the crucial question: What causes the large amount of variation in death rates unexplained by the MedisGroups admission score? Further study is needed to answer this question so that the MedisGroups information can be used in an appropriate and valid fashion. ☐

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APPENDIX—Description of MedisGroups

Selection of Key Clinical Findings

Assignment of MedisGroups severity scores derives from the number, type, and weights of the Key Clinical Findings (KCFs) identified for each individual case. More than 250 potential KCFs are considered, using patient history; physical examination; and laboratory, radiology, pathology, and procedure results to indicate clinical abnormalities. All KCFs are used in computing admission scores, but only a subset of KCFs is involved in deriving the mid-stay review score.

The admission review aims to reflect both acute clinical derangements and more chronic conditions. It encompasses the first two calendar days of the hospital stay for medical patients. For surgical patients, the timing of the admission review depends on when the operation takes place. The intent is to capture all aspects of the surgery, including pathological findings, as part of the admission review. The worst values obtained during this period are collected to compute the admission score.

The so-called "mid-stay review" aims to identify acute or subacute "morbidity" following the admission period. Although all KCFs are collected and all physiological derangements are considered, the mid-stay review computation disregards most chronic or prolonged manifestations of disease. For example, abnormal arterial blood gases in a patient with COPD are included, whereas the chest radiograph finding of COPD would be excluded. The MedisGroups algorithm classes the KCFs used for this mid-stay rating as "acute" (e.g., hematocrit, glucose, blood pressure, pulse, coma, and ventricular fibrillation on electrocardiogram) or "persistent" (e.g., ascites on ultrasound, extensive burns, congestive heart failure on chest radiograph, disorientation, and pulmonary embolism on arteriography).

For most medical cases, the mid-stay review encompasses days 3 through 7 of the hospital stay. For most surgical cases, this review covers the five days following surgery. The worst values obtained during the mid-stay period are collected, but information on vital signs and 10 laboratory KCFs must come from the last 48 hours of the period. Patients generally do not receive a mid-stay review if discharged alive during the designated period.

Scoring

Individual KCFs are assigned weights or "groups" from 0 to 3; group 3 findings indicate a serious clinical derangement and imminent risk of organ failure. Examples of group 0 KCFs include history of congestive heart failure, heart murmur on physical examination, colonic polyp on colonoscopy, serum sodium greater than 128 mmol/L, systolic blood pressure greater than or equal to 60 mmHg, and spinal cord compression found on computed tomography. There are very few group 3 findings; they include coma or stupor on neurological examination, arrest with resuscitation, burns covering greater than 25 percent of body surface area, hematocrit less than 20.0 percent, and systolic blood pressure less than 60 mmHg. Although computation of scores disregards patient age, special pediatric ranges are specified for selected continuous KCFs, and a number of KCFs apply only to neonates.

Employing the algorithm shown in Table A, admission severity scores from 0 to 4 are computed based on the KCFs identified and their weights (i.e., group assignments from 0 to 3), regardless of diagnosis. Using the designated "acute" and "persistent" KCFs, the mid-stay review score is also computed independently of diagnosis, and it results in three classes: no morbidity, morbid, and major morbidity (Table B).

TABLE A—Meaning and Computation of Admission Scores

Score	Meaning of Score	Computation of Score
0	No significant findings	All other, such as cases with multiple group 0 KCFs
1	Minimal findings, indicating a low potential for organ failure	One or two group 1 KCFs
2	Either acute findings connoting a short time course with an unclear potential for organ failure, or severe findings with high potential for future organ failure	One group 2 KCF *or* Three or more group 1 KCFs
3	Both acute and severe findings indicating a high potential for imminent organ failure	One group 3 KCF *or* Two or more group 2 KCFs
4	Critical findings indicating the presence of organ failure	Two or more group 3 KCFs

TABLE B—Meaning and Computation of Mid-Stay Score

Mid-Stay Score	Computation of Mid-Stay Score
No morbidity	All other
Morbid	One group 2 acute KCF *or* One or more group 2 persistent KCFs
Major morbidity	One or more group 3 acute KCF *or* More than one group 2 acute KCF *or* One or more group 2 acute KCF *and* one or more group 2 persistent KCF

The Impact of HIV-Related Illness on Employment

ABSTRACT

We used structured telephone interviews to determine the extent of work loss following onset of symptoms, the interval between onset of symptoms and cessation of work, and the risk factors for work loss among 193 persons with symptoms of human immunodeficiency virus (HIV)-related illness attending the AIDS Clinic at the University of California, San Francisco, between October 1, 1988, and September 30, 1989. Estimates of the duration of time between onset of HIV-related symptoms and work loss derive from the life table method of Kaplan and Meier. A Cox proportional hazards model is used to estimate the effect of risk factors on the probability of withdrawing from work in each time interval. Eighty-six percent of the respondents worked prior to onset of the first symptom of HIV-related illness; 40 percent were working at the time of the most recent interview, a mean of 958 days later. The total number of hours worked declined by 59 percent during this time. Kaplan-Meier analysis indicates that 50 percent who worked prior to onset of HIV-related illness stopped working within two years and all had stopped within 10 years after onset of the first symptom. (*Am J Public Health* 1991; 81:79–84)

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Introduction

The economic cost of acquired immunodeficiency syndrome (AIDS) has been the subject of numerous studies.[1-28] Several analysts have noted that the largest component of the cost of human immunodeficiency virus (HIV)-related illness is due to lost work rather than to direct expenditures for medical care,[1-3] reflecting onset of this condition among persons in the first half of their careers. However, to date there have been no direct estimates of the magnitude of such work loss. For example, in the first comprehensive study of work loss due to HIV-related illness, Hardy, *et al*,[1] applied estimates from Rivin, *et al*,[4] to persons in their samples. Rivin, *et al*, in turn, relied on physicians' recall of their patients' work status in the three months prior to a telephone interview or, if the patients had previously died, in the three months prior to death. Scitovsky and Rice[2] assumed that any person alive at the end of a year was too ill to work 60 percent of the time and that anyone who had died during the year was unable to work at all in that year. The Rivin, *et al*, estimates depended on physicians collecting and remembering information about work status; the Scitovsky and Rice estimates depended on assumptions about the productivity of individuals with AIDS or AIDS-related complex (ARC), assumptions that they did not test directly.

The present study is designed to provide more direct information about the impact of HIV-related illness on loss of employment, clearly the largest component of the cost of these conditions.

Methods

We collected data from persons attending the AIDS Clinic at the University of California, San Francisco (UCSF), which provides medical care to persons with all stages of HIV-related disease. We use those data to quantify 1) the percentage of those employed prior to the first onset of symptoms with HIV-related illness and the percentage employed at the time of the most recent interview; 2) the change in the length of the workweek between the first onset of symptoms and the time of the most recent interview; and 3) the interval between the first onset of symptoms and the cessation of work activities. In addition, we describe the medical and demographic characteristics of persons with HIV-related illness as well as the characteristics of their jobs that are associated with the cessation of work.

Sampling

The sampling frame for this study consists of all 293 persons with HIV-related illness attending a randomly chosen session of the UCSF AIDS Clinic between October 1, 1988, and September 30, 1989. These 293 persons were offered enrollment in the clinic setting; completed telephone interviews eventually were conducted with 193 of them (66 percent). Study respondents are interviewed three times annually to provide an update on health status, medical care usage, and employment history. As of December 1989,

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TABLE 1—Characteristics of Study Respondents

Characteristic	All Study Respondents (%) (n = 193)	Study Respondents with a Work History (%) (n = 170)
Age[a]	39 ± 8	38 ± 7
Male	96	97
Ethnicity		
White, non-Hispanic	82	81
Black	9	8
Hispanic	6	7
Other	3	3
Highest grade attained		
High school or some college	31	28
Bachelor of arts (BA) degree	49	50
More than BA degree	21	22
Occupation		
Professional/manager		28
Clerical/sales		28
Crafts/operatives/manual		18
Service worker		26
Income before onset of first symptom (000 1989 $s)[a]	27 ± 7	30 ± 7
Risk group		
Male homosexual	85	84
Transfusion	3	2
Intravenous drug user	12	13
Diagnosis		
Acquired immunodeficiency syndrome	55	57
Aids-related complex	28	28
History		
Kaposi's sarcoma	26	29
Pneumocystis carinii pneumonia	34	34

[a]Mean ± standard deviation.

97 respondents had been due for reinterview. Of these, nine had died, two refused continued participation because of illness, nine were lost to follow-up, and 77 were reinterviewed. Four persons who were reinterviewed subsequently died, as did one individual not yet due for reinterview.

Study Instruments

The principal data collection instrument is a structured, closed-ended telephone survey conducted by a trained interviewer who asks respondents to report whether they experience each of 20 common symptoms of HIV-related illness, (e.g., weight loss, fever, night sweats) and when the onset of each occurred; whether they experience each of 20 common medical conditions associated with HIV-related illness (e.g., Kaposi's sarcoma, *Pneumocystis carinii* pneumonia) and when the onset occurred; whether they have been told by a physician that they meet the standard criteria for AIDS or ARC, and when they were told so. The respondents provide a complete record of their current medications and those they have taken in the past for HIV-related illness. Following standard protocols for studies measuring labor force participation,[29] the respondents also provide an employment history for the time at which they noticed the first symptoms of HIV-related illness and at the time of the interview. In the employment history, respondents report whether they were employed, looking for work, out of the labor force, or disabled when they first noticed symptoms of HIV-related illness. If they were working, they report hours worked per week, occupation, and industry, and answers to a checklist of working conditions. They then provide the identical information for the day of the interview. Respondents who stopped working in the interim report the approximate date on which they left employment.

Data Analysis

The goal of the analysis is to describe the employment consequences of HIV-related illness among study respondents. We measure the impact of such illness in terms of actual work status—whether the individal is employed for pay in the labor market and, if so, the hours of employment. Thus, we do not measure the impact of HIV-related illness on those who have lost function but are not gainfully employed.

Estimates of the duration of time between onset of symptoms (or diagnoses) and cessation of work activities derive from the life table method developed by Kaplan and Meier,[30] with the censored cases being those who continued to work until the date of the most recent interview or who have been lost to follow-up. A Cox proportional hazards model[31] is used to estimate the effect of the respondents' demographic and medical characteristics, as well as of their job characteristics on their probability of withdrawing from work in each time interval.

The estimates of time to cessation of work activities reported here may be conservative. First, in attempting to renew contact with some of the respondents, we found that many have moved out of the area so that they could be cared for by parents or siblings and have, therefore, left work; such persons are recorded as being lost to follow-up. Second, of the 14 individuals who died subsequent to the first interview, 13 worked prior to onset of HIV-related symptoms. Of these, 6 stopped working by the last time we interviewed them. For the 7 others, for whom we could not establish the actual date on which work activities ceased, we arbitrarily assigned the date of data analysis (September 1, 1989) for the cessation of work activities. This strategy inflates the estimates of time between onset of symptoms and work loss.

Results

Table 1 shows the demographic characteristics of all study respondents and of those with a work history. Almost all are males, most are non-Hispanic Whites, and more than two-thirds finished college. Although a majority worked in white-collar occupations prior to the onset of HIV-related illness, sizable minorities were employed in service work or manual labor.

Table 2 summarizes the symptomatic history of the study respondents. Ninety-six percent reported having at least one potential symptom of HIV-related illness. On average, the symptomatic respondents experienced their first symptom 958 days prior to the most recent inteview, although the responses ranged from 0 days to more

TABLE 2—Symptomatic History of Study Respondents

Symptom	Percent with Symptom (n = 193)	Duration with Symptom, in Days (Mean, ± Standard Deviation, Range)
One or more symptoms of any kind[a]	96	958 ± 677, 0–3, 931
One or more neurological symptoms[b]	60	604 ± 521, 0–3, 931
One or more symptoms of dementia[c]	31	525 ± 336, 0–1, 353
One or more physically limiting symptoms[d]	45	831 ± 584, 0–3, 210

[a] Includes night sweats, diarrhea, shortness of breath, chronic cough, weakness, fatigue, confusion, memory loss, vomiting, pain, changes in sensation, loss of vision, skin lesions, oral thrush.
[b] Includes subset of confusion, memory loss, changes in sensation, loss of vision.
[c] Includes subset of confusion, memory loss.
[d] Includes subset of shortness of breath, weakness, fatigue, pain, loss of vision.

TABLE 3—Productivity of Study Respondents Prior to First Symptom and at Time of Most Recent Interview

	Prior to First Symptom	
All Workers (*n* = 166, 100%)	Full-time Workers (*n* = 146, 88%)	Part-time Workers (*n* = 20, 12%)
	Hours/Week: Mean, Total, Percent	
38.4, 6,381, 100%	40.7, 5,938, 93%	22.2, 443, 7%
	At Time of Most Recent Interview	
All Workers (*n* = 77, 100%)	Full-time Workers (*n* = 51, 66%)	Part-time Workers (*n* = 26, 34%)
	Hours/Week: Mean, Total, Percent	
34.0, 2,616, 100%	40.4, 2,061, 79%	21.3, 555, 21%

than 10 years. Sixty percent of the respondents reported one or more neurological symptoms lasting slightly more than 600 days on average; fewer than a third reported symptoms of dementia, and just slightly fewer than half reported a physically limiting symptom.

At the time of the first symptom of HIV-related illness, 166 respondents (86 percent), were working and 27 (14 percent), were not. This breakdown is very similar to the 84 percent labor force participation rate among all 35–44-year-olds in the United States.[32] At the time of the most recent interview, however, only 77 respondents (40 percent) were working. This figure represents a decrease of 54 percent in the labor force participation rate of the study respondents. Seventy-three persons, or only 44 percent of those who were employed prior to noticing the first symptom of HIV-related illness, were still working at the time of interview. In contrast, 93 individuals, or 56 percent of those employed prior to the first symptom, were no longer working.

Table 3 summarizes the productivity dynamics among the study respondents. The 166 persons who worked prior to the first symptom of HIV-related illness averaged slightly more than 38 hours a week, or 6,381 hours total; 88 percent of them were employed full time. The full-time workers accumulated 5,938 hours per week, or 93 percent of all hours worked. The 77 persons who were working at the time of the most recent interview averaged 34 hours work per week. Their total work time, 2,616 hours, represents a decrease of 59 percent in productivity, with a much larger share of the total hours being accumulated by part-time workers. In fact, the number of part-time workers increased absolutely (from 20 to 26) and relatively (from 12 percent to 34 percent), as did the number and relative share of part-time hours (from 443 [7 percent] prior to the first symptom to 555 [21 percent] at time of interview).

Table 4 apportions the productivity gains and losses of the study respondents by their work histories over the average of 958 days between the first notice of symptoms and the most recent interview. Four respondents began working after the onset of the first symptom of HIV-related illness and another three increased their hours. Forty-nine persons (29 percent of respondents) did not change their hours at all between first onset of a symptom and the most recent interview. Slightly more than 12 percent continued to work, but with reduced hours. Those who stopped working altogether constitute the largest group of respondents (55 percent), and their lost productivity, 3,510 hours, accounts for 90 percent of the overall reduction in hours.

Figure 1 presents Kaplan-Meier estimates of the time to cessation of employment among persons working at the first notice of symptoms. Among all study respondents who had one or more symptoms and who worked prior to the onset of HIV-related illness, 10 percent had stopped working within 100 days of their first symptom (95 percent CI-5, 15). Within a year, 28 percent had stopped working (95 percent CI-21, 36); by two years, 48 percent had done so (95 percent CI-40, 56); by four years, 69 percent had left work (95 percent CI-59, 79); and by 10 years, none was still employed. Among persons who would ultimately develop neurological symptoms, 30 percent had stopped working prior to doing so; among those remaining, 19 percent had stopped working in the first days after onset of neurological symptoms (95 percent CI-10, 28). No respondent with neurological symptoms has been followed for longer than 1,886 days, by which point the 84 percent who were employed when they developed the first neurological symptoms had stopped working (95 percent-CI 58–100).

Figure 2 provides estimates of the time between specific HIV-related diagnoses and the cessation of work activities. Fourteen percent of persons with AIDS had stopped working prior to receipt of that diagnosis. Thereafter, 10 percent had stopped working in the first days after diagnosis (95 percent-CI 3–16), 40 percent had stopped working within a year (95 percent-CI 29–51), and 93 percent were no longer employed as of 1,986 days after diagnosis (95 percent-CI 80–100), the longest any respondent with AIDS has been followed. Of those with ARC, 40 percent had stopped working prior to formally receiving that diagnosis. Thereafter, the proportion working fell steadily, but at an initially slower rate than that of persons diagnosed with AIDS. Ultimately, however, the proportion of working persons with ARC reached zero. Work loss oc-

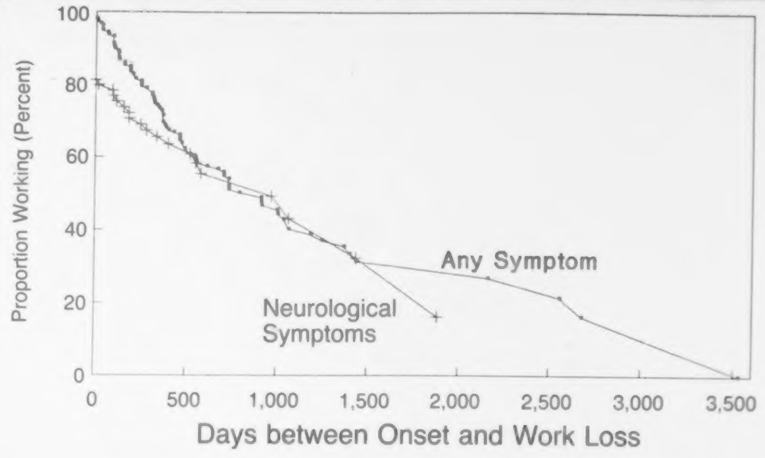

FIGURE 1—Time between Onset of Symptoms and Work Loss

curred more slowly for persons classified as asymptomatic, with 30 percent leaving work by 1,003 days (95 percent-CI 1–59), the longest any respondent formally so classified has been followed.

In a separate analysis, we compared the time between diagnosis of AIDS and cessation of work for persons with Kaposi's sarcoma and those with other conditions that result in the AIDS diagnosis (not shown in Figure 2). This comparison yielded only equivocal evidence that persons with Kaposi's sarcoma are likelier to leave work in each time interval than those with other AIDS-related diagnoses (p = .24 by Wilcoxin test).

In Table 5, we present estimates of the proportional hazard of work loss associated with characteristics of the respondents and of the jobs they held at the time they first noticed symptoms of HIV-related illness. A proportional hazard less (greater) than 1.0 indicates that the person with the risk factor is less (more) likely to stop working in each time interval after onset. Persons with a diagnosis of AIDS stopped working at much higher rates than those who were diagnosed with ARC or who were asymptomatic. Age, a history of male homosexuality or intravenous (IV) drug use, union status, and job tenure did not affect work status. Members of minorities were slightly, though not significantly, more likely to stop working than non-Hispanic whites. The nature of work at the job held at the first onset of symptoms, however, did affect subsequent work status. The proportional hazard of work loss associated with an increment of *each* of the 11 physical requirements of the job was 1.09, indicating that persons with very physically demanding work would have much higher rates of work loss than those in sedentary occupations. Conversely, the proportional hazard of work loss associated with an increment of *each* of the nine measures of discretion in work activities was .93, indicating that persons who controlled the pace and scheduling of work activities were much less likely to leave employment.

Discussion

Both the individuals with HIV-related illness and the society of which they are a part have a strong interest in sustaining the employement of these individuals for as long as possible. Doing so brings such benefits as the sense of well-being they get from continuing in work despite illness, the relatively high income they generate from employment (an average of $30,000 a year prior to the onset of HIV-related illness among the study respondents), and the taxes they pay. The cessation of work on the other hand, initiates one series of entitlements and hastens the day when others will begin. Most persons with HIV-related illness who leave work will apply for unemployment insurance immediately. Those with a diagnosis of AIDS will be eligible for Supplemental Security Income (SSI) as well. If such persons had private disability policies through work, they may begin to collect on them. For those who did not have health insurance through a former em-

TABLE 4—Productivity Gains and Losses

			Hours								
			Prior to First Symptom			Most Recent Interview			Change		
	Persons		Hours/Week			Hours/Week			Hours/Week		
Data Partition	N	%	Mean	Total	%	Mean	Total	%	Mean	Total	% Loss (Gain)
Did not work prior to 1st symptom, worked at interview	4	2	0	0	0	29.0	116	4	29.0	116	(78)
Worked prior to 1st symptom, reduced hours	21	12	42.1	884	14	22.9	480	18	−19.2	−404	10
Worked prior to 1st symptom, same hours	49	29	38.9	1,908	30	38.9	1,908	73	0	0	—
Worked prior to 1st symptom, increased hours	3	2	26.3	79	1	37.3	112	4	11.0	33	(22)
Worked prior to 1st symptom, stopped working before interview	93	55	37.7	3,510	55	0	0	0	−37.7	−3,510	90
Total	170	100	37.5	6,381	100	15.4	2,616	100	−22.1	−3,765	59

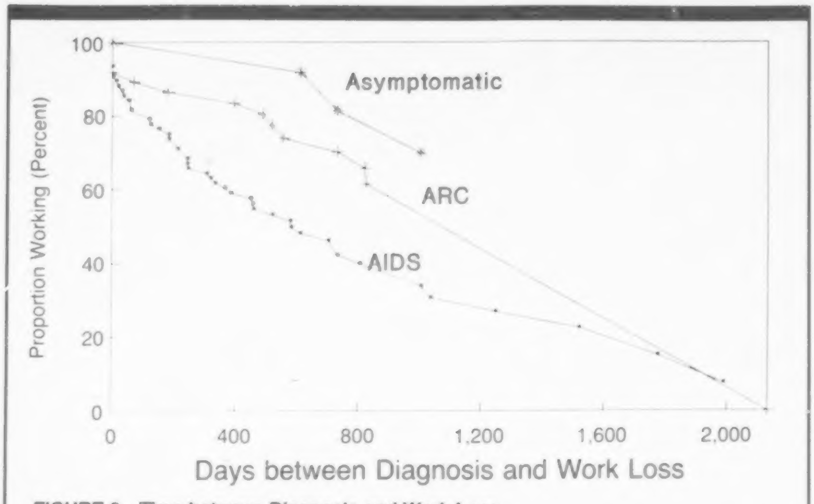

FIGURE 2—Time between Diagnosis and Work Loss

TABLE 5—Impact of Medical and Social Characteristics of Respondents and of Their Jobs on Subsequent Work Status

Characteristic	Proportional Hazard (95% Confidence Interval)	p-value[a]
Age/year	0.99 (0.96, 1.03)	.94
Minority race	1.71 (0.94, 3.13)	.07
Acquired immunodeficiency syndrome	2.73 (1.02, 7.35)	.04
Aids-related complex	1.21 (0.42, 3.52)	.72
Male homosexual	0.61 (0.24, 1.59)	.30
Intravenous drug user	0.30 (0.03, 2.92)	.29
Physical requirements of jobs[b]	1.09 (1.01, 1.17)	.03
Discretion over work[c]	0.93 (0.87, 0.99)	.02
Member of labor union	0.76 (0.40, 1.43)	.38
Tenure on job: years	0.99 (0.99, 1.01)	.99

[a] *p*-value by chi-square test.

[b] Count of physical requirements of jobs, including walking, using stairs, standing or sitting for long periods, stooping, reaching, using eyes for reading or inspection, concentrating or memorizing, using computers, using fingers to grasp, lifting 25 lbs.

[c] Count of discretion over work activities, including pace of work, work procedures, what is produced, time of breaks, sick leave, time of arrival and departure.

ployer, most will be granted Medicaid; those who *did* have health insurance through work, can retain it—at their own expense—only for a year and a half, and then they too will apply for Medicaid. Finally, if they survive the waiting period, they may collect Social Security Disability Insurance (SSDI) and, subsequently, most of those receiving SSDI will become entitled to Medicare.

These potential consequences of work loss following onset of HIV-related illness have been noted before, and there is evidence that the growth in entitlement that follows the cessation of employment has already begun.[4,5,10,18-21,25,26]

There are other compelling reasons as well for understanding the impact of HIV-related illness on employment. As these illnesses become more like other chronic conditions, interventions that maintain function will begin to take precedence over those that merely prolong survival, especially at the cost of function.[33]

There are few data with which to estimate the magnitude of work loss related to HIV-related illness, however. Although the current study is designed to provide direct estimates of such work loss, limitations in the study design may limit the generalizability of these estimates. The study population, although apparently reflective of persons with HIV-related illness in the San Francisco Bay Area,[4,5,34] probably includes a disproportionate number of male homosexuals and persons with a work history compared with the national population of persons with HIV-related illness. Sampling within a clinic setting may also bias the estimates, although after using procedures designed to correct for this problem through weighting,[35-36] we could not detect such a bias and, accordingly, reported the unweighted results above. Finally, the results may be sensitive to the nonparticipation rate.

We found that among all persons with at least one symptom of HIV-related illness, half had stopped working within two years of onset and all had stopped within a decade. Most of the lost productivity is due to total cessation of work rather than to reduced hours. Given that the average age of the study respondents is only 38, most will lose well over half of their careers.

As one might expect, persons who have received a diagnosis of AIDS were at higher risk to stop working in each interval between the first onset of symptoms and the most recent interview than those who have been diagnosed with ARC or who are classified as asymptomatic. Contrary to expectation, risk status—history of male homosexuality or IV drug use—was not associated with work status. Persons who reported that the job they held when they first noticed symptoms of HIV-related illness required more physical exertion and those who reported less discretion over the pace and scheduling of work activities were likelier to withdraw from work in each interval between onset and interview, a finding consistent with studies of work loss after onset of rheumatoid arthritis,[37-38] all forms of musculoskeletal disease,[39] and chronic disease generally.[40] This finding suggests that one way to forestall work loss would be to refer persons with HIV-related illness to less physically demanding work and to jobs in which the employee has discretion over the pace and scheduling of tasks. However, given that the work disability rate eventually reaches unity, any such attempt will have but a temporary effect.

The data reported here reflect the current therapy available at a tertiary care center over the past several years. Advances in treatment could dampen the rate at which work loss occurs among persons with HIV-related illness and, in doing so, prove highly cost-effective. A change in attitudes among employers might alter the willingness of afflicted persons to persevere in the face of illness. The addition of long-term care to the typical workplace-based health insurance policy might remove the incentive to leave work to obtain long-term-care services. In advance of such changes, we find that work loss after onset of HIV-related illness is a pervasive phenomenon. □

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Reporting of Occupational Injury and Illness in the Semiconductor Manufacturing Industry

ABSTRACT

In the United States, occupational illness and injury cases meeting specific reporting criteria are recorded on company Occupational Safety and Health Administration (OSHA) 200 logs; case description data are submitted to participating state agencies for coding and entry in the national Supplementary Data System (SDS). We evaluated completeness of reporting (the percentage of reportable cases that were recorded in the company OSHA 200 log) in the semiconductor manufacturing industry by reviewing company health clinic records for 1984 of 10 manufacturing sites of member companies of a national semiconductor manufacturing industry trade association. Of 416 randomly selected work-related cases, 101 met OSHA reporting criteria. Reporting completeness was 60 percent and was lowest for occupational illnesses (44 percent). Case-description data from 150 reported cases were submitted twice to state coding personnel to evaluate coding reliability. Reliability was high (kappa 0.82–0.93) for "nature," "affected body part," "source," and "type" variables. Coding for the SDS appears reliable; reporting completeness may be improved by use of a stepwise approach by company personnel responsible for reporting decisions. (*Am J Public Health* 1991; 81:85–89)

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Introduction

Occupational injuries and illnesses represent an important health and economic cost in the United States. The US Department of Labor recorded more than six million cases of reportable occupational injuries and illnesses in 1987, including more than 50 million lost work days.[1] Health and economic consequences for individual workers due to occupational disorders range from trivial to devastating.

Epidemiologic study of occupational disorders has been hindered by the lack of a comprehensive reporting system providing reliable and consistent statistics.[2] The Occupational Safety and Health Act of 1970 attempted to address this problem by mandating the nationwide collection and analysis of statistics on occupational illnesses and injuries meeting specified reporting criteria.[3] The act defines an occupational injury as a disorder that results from an instantaneous exposure (e.g., an impact or fall) occurring in the work environment. Disorders resulting from work exposures that are not instantaneous are considered illnesses. Reporting is mandatory for all cases of occupationally related deaths, all occupational illnesses, and those occupational injuries meeting at least one of four reporting criteria; 1) injuries requiring medical treatment other than first aid, 2) restriction of work or motion, 3) termination or transfer to another job due to the injury, and 4) loss of consciousness.[3]

Each reportable case (and associated lost or restricted work days) is recorded in the company Occupational Safety and Health Administraiton (OSHA) 200 log and classified as an injury or one of the following seven categories of occupational illness: skin diseases, dust diseases of the lungs, toxic respiratory conditions, systemic poisonings, disorders due to physical agents, disorders due to repetitive trauma, and other occupational illnesses. A sample of approximately 280,000 establishments is selected annually to forward a summary of information from the OSHA 200 log to the Bureau of Labor Statistics (BLS) for analysis and subsequent publication.[4] Additional information, including job title and description of the incident and resultant disorder, is recorded on an OSHA 101 form or equivalent state worker's compensation insurance form, which constitutes the Supplementary Data System (SDS). Coding for the SDS is performed by participating state agencies; in California the responsible agency is the California Department of Industrial Relations (CDIR).

In spite of the importance of these data, little research has been conducted to assess the completeness or reliability of reporting for OSHA-reportable conditions. We report here the results of an investigation of reporting of illness and injury in accordance with OSHA reporting criteria among members of the Semiconductor Industry Association (SIA). In addition, two samples of SDS forms were submitted to the CDIR to evaluate the reliability of coding decisions.

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TABLE 1—Recording by Industry of 101 Reportable Cases

Category[a]	Total Cases n (%)	Recorded as illness n	Recorded as injury n	Total Recorded n	Reporting Completeness %
Reportable injury	57 (56)	0	32	32	56
Reportable indeterminate	28 (28)	2	20	22	79
Reportable illness	16 (16)	2	5	7	44
Occupational death	0 (0)	0	0	0	—
Total	101 (100)	4	57	61	60

[a] Determined by authors based on Department of Labor criteria.[3]

Methods

Population

The SIA is a national trade association of semiconductor manufacturing firms (Standard Industrial Classification code 3674). In 1982, the SIA sponsored the development of the Occupational Health System (OHS), a prospective computerized data collection system operating in parallel with the governmental OSHA 200 reporting system. Sixteen companies comprising 37 plant sites and employing more than 96,000 workers, or approximately one-third of semiconductor manufacturing employees in the US in 1984,[4] participated in the OHS. All manufacturing sites participating in the OHS in 1984 agreed to participate in an evaluation of their recording practices.

Company Health Record Review

We evaluated the reporting completeness and reliability of case description data for 1984. Review of cases from the company clinic daily log was conducted at a sample of sites chosen on the basis of a stratified sampling scheme. The 10 sites contributing the most OSHA-reportable cases (median reported cases, 175; median number of employees, 5,951) and a random sample of six of the remaining 27 sites (median reported cases, 24; median number of employees, 920) were selected for site visits.

We examined the daily clinic log for 1984 and selected four work-related cases per month at random from each site. Only cases that the employer had previously determined to be work-related were sampled. When it was available, the abstracter also reviewed the OSHA 101 form (or equivalent state form for the workers' compensation employer's first report), the form for the physician's first report, and the case's personal employee health clinic chart.

If the exposure or event causing the employee's disorder was considered by the abstracter to be instantaneous, the case was classified as an injury. All lacerations, contusions, sprains, strains, and thermal burns were presumed to represent injuries unless the records explicitly indicated that the exposure causing the disorder was not instantaneous. Cases that were likely to have resulted from exposures that were not instantaneous were classified as illnesses. Examples include contact dermatitis due to gloves or creams, acid burns on the hand discovered after the removal of a faulty protective glove, and disorders due to repetitive trauma. Cases in which it could not be determined whether the exposure causing the disorder was instantaneous (e.g., "acid burn on hand") were classified as indeterminate.

We defined the reportability of cases according to BLS guidelines applicable in 1984.[3] The reportability for indeterminate cases was decided according to criteria for occupational injuries. Reporting criteria for injuries and indeterminate cases and work-related death were assumed to be absent unless specifically noted otherwise in the records.

The OSHA 200 form was reviewed to determine if the reportable cases had been recorded. Reporting completeness was calculated as the percentage of cases meeting OSHA reporting criteria that was recorded in the company's OSHA 200 log.

Reliability of SDS Classification

We received 1,117 OSHA 101 or equivalent state workers' compensation forms from a random 50 percent sample of OSHA 200 cases from 1984, as reported previously.[5] Of these, a random sample of 150 forms was submitted to the CDIR without data on the nature, type, source, and body part involved that could identify the person or the company. The initial classifications were stored and the forms were resubmitted without identifying data for repeat classification. The CDIR nosologists received the materials in batches and were not aware that some of the forms had been previously classified. Reliability was calculated as the kappa statistic.[6] Statistical analysis was conducted on a VAX 11/750 computer using the Statistical Analysis System (SAS) software package.[7]

Results

Sixteen sites, representing 66,968 employees, were selected for review. Six sites were not included because they did not have daily clinic logs or supporting records for 1984 suitable for participation in this study, leaving 10 sites representing plants in six states distributed across the US. These 10 sites consisted of seven from the stratum of 10 large case contributors and three from the stratum of six facilities representing the remaining sites.

We reviewed 416 randomly selected work-related cases from the clinic logs. Personal employee health charts were available in 249 (60 percent) of these cases. These records were not available in the remaining cases because of the inability of the companies to locate the records because of loss, transfer, or termination of the employee. There were 101 cases (24 percent) that met reportability criteria for the OSHA 200 form. The median number of reportable cases per site was 8.5 (range: 0–29).

Of the 101 reportable cases, 57 (56 percent) were injuries, 28 (28 percent) were indeterminate cases that met the reporting criteria for injuries, and 16 (16 percent) were occupational illnesses (Table 1). Fourteen (88 percent) of the occupational illness cases represented skin conditions, and the remainder were due to cumulative trauma. Sixty-one (60 percent) of the 101 reportable cases were recorded on the company OSHA 200 form. The completeness of reporting ranged from 13 percent to 100 percent at the nine participating sites with reportable cases. No association was observed between employee population size or the number of reportable cases at a site and reporting completeness. Because reporting completeness was similar in the two sample strata, the strata were combined for analysis.

TABLE 2—Reliability of Classification for 150 Reportable Cases of Occupational Injury or Illness

Classification Variable	Kappa
Nature of injury or illness	0.92
Strain, sprain	0.95
Cut, laceration, puncture	1.00
Chemical burn	0.87
Contusions, crushing injuries, bruise	0.96
Affected body part	0.93
Back	1.00
Finger(s)	0.97
Eye(s)	0.96
Hand (not wrist or fingers)	0.92
Source of injury or illness	0.83
Boxes, crates, cartons, cases	0.97
Hydrofluoric acid	0.96
Bodily motion	0.75
Floor	0.79
Type of injury or illness	0.82
Overexertion in lifting object	0.93
Contact with radiation, caustics, etc. (by skin absorption)	0.94
Fall onto walkway or working surface	0.78
Bodily reaction	0.75

Of the 61 reportable cases recorded on the OSHA 200 form, 32 (52 percent) were classified by the abstracter as recordable injuries, 22 (36 percent) were classified as recordable indeterminate cases, and 7 (11 percent) were classified as occupational illnesses (Table 1). Of the 7 illness cases that were reported, 5 (71 percent) were misclassified as occupational injuries. Three of these cases were occupational skin diseases and two were illnesses due to repeated trauma.

For the combined 85 cases of reportable injuries or reportable indeterminate cases, 55 (65 percent) were reportable because of the use of medical therapy beyond first aid and 33 (39 percent) were reportable because of restriction of work motion. Reporting completeness was 78 percent for restriction of work motion cases and 56 percent for medical therapy cases. Reporting completeness was lowest for illnesses. No cases of loss of consciousness or termination or transfer due to an injury and no occupational deaths were observed.

Of the 40 reportable cases that were not recorded on company OSHA 200 logs, 25 (63 percent) were classified by the abstracter as reportable injuries, 9 (23 percent) were occupational illnesses, and 6 (15 percent) were reportable indeterminate cases. The most common reportability criteria among the injury and indeterminate cases were use of medical therapy other than first aid (24 cases) and restriction of work or motion (8 cases). All of the 9 unreported occupational illnesses represented skin disease cases.

Reliability of SDS Classification

The reliability of classification by the CDIR was calculated as the kappa statistic and varied from .82 for type of condition to .93 for affected body part (Table 2). There was little variation in the kappa values between categories within nature, part, type, and source variables.

Discussion

Occupational morbidity imposes an important health and economic burden on individual workers, employers, and society. Primary prevention plays an important role in minimizing this burden. Preventive measures, although generally more cost-effective than treatment, require directed use of resources, and accurate epidemiologic information is needed to guide the application of these resources. The BLS report of occupational injuries and illnesses offers the only nationwide statistics for occupational injuries and illnesses based on standardized reporting criteria. We report the results of our evaluation of reporting completeness within a large and important industry and the reliability of coding for case description data by a state agency participating in the SDS.

A major goal of this study was to evaluate the reporting completeness for conditions that the employer considered work related. Cases that were not recognized as work related would not have been included in the study. True occupational cases may be missed if the employee does not seek medical attention or if the treatment practitioner or employer does not recognize the occupational relationship. Failure to recognize an occupational etiology is particularly likely for illnesses due to chronic exposures and characterized by subtle manifestations or long latencies, such as cancer, neurologic disease, and reproductive disorders. Lack of severity, incomplete medical evaluation, and inadequate recording practices may also lead to underreporting.

In the early 1980s OSHA implemented a site-inspection policy that focused inspections away from establishments that reported low injury rates, raising concern that this policy may promote underreporting. However, examination of these factors and estimation of the true rate of occupational injury and illness would have required active surveillance to capture true cases that would otherwise be undetected and were beyond the scope of this study.

Our findings suggest that the BLS data significantly underestimate incidence of occupational injuries and illnesses. If the 60 percent reporting completeness we observed for conditions recognized by the employer as work related is representative of other industries, the incidence may be nearly 70 percent higher than reported. The underestimation is most significant for occupational illnesses, for which the 44 percent reporting completeness we observed suggests that the incidence may be almost 130 percent higher than reported. The true incidence of occupational conditions is likely to be significantly higher, because the estimates calculated above are based upon observed reporting of conditions recognized by the employer as work related.

Among injury and indeterminate cases, the highest reporting completeness occurred for cases characterized by restriction of work or motion. Injuries and indeterminate cases characterized by the need for medical treatment were less likely to be recognized as reportable. Thus, BLS data are likely to be most valid for conditions such as injuries that directly affect the ability of a worker to perform a job.

The results of this investigation may have been affected by selection bias. The companies studied are members of a large trade association and may not be representative of this industrial sector with respect to reporting performance. Companies not belonging to the trade association may have fewer resources to devote to surveillance and prevention of occupational conditions. Thus, reporting completeness in the group we studied may be higher than for nonmembers. Because the firms participating in this study represent a large fraction of this important industrial sector, we do not believe that any selection bias would have seriously altered our findings and conclusions.

Information bias may also have affected our observed results. Personal employee health charts to supplement data contained in the clinic log were not available for approximately 40 percent of the 416 cases selected for review. Although the clinic logs were generally the most helpful sources of information, personal employee health charts could have contained information indicating a reportable condition. By not reviewing all of these, we may have overestimated reporting completeness. Reporting completeness for occupational illnesses may have been overestimated because indeterminate cases were considered reportable only if they met reporting criteria for injuries. In other words, some indeterminate cases not meeting reporting criteria for injuries may have actually been illness cases but would not have been recognized and classified as reportable in this study. In addition, we presumed that reporting criteria were absent unless they were specifically noted as present; incomplete or incorrect medical record entries could have contributed to erroneous classification with respect to reportability.

Although the influence of these potential biases is difficult to quantify, the data indicate that significant underreporting for occupational disorders, especially illnesses, occurred in the semiconductor manufacturing industry. The increased underreporting for occupational illnesses is significant because the semiconductor manufacturing industry is chemically intensive,[8,9] and illnesses represent a greater proportion of OSHA-reportable cases in this industry than in the manufacturing sector in general.[10] Although the absence of a control industry in this investigation limits comparison with other industries, underreporting has been documented in recent studies of other industries. Eisenberg and McDonald[11] observed an underreporting rate of approximately 20 percent in a pilot investigation of OSHA-reporting practices in 192 manufacturing establishments in Massachusetts and Missouri.

Other investigations have attempted to assess the true rates of occupational conditions. For occupational deaths, estimates of underreporting from 30 to 50 percent have been reported.[12,13] A recent investigation by Blanc and coworkers[14] evaluated the usefulness of occupational illness surveillance using Poison Control Center data. These investigators suggested that the true incidence of occupational illness is three to five times current estimates. Thus, significant underreporting is likely to occur in other manufacturing industries, and a review of underlying causes and possible remedies discussed here may be valuable for industry groups not represented in this investigation.

We also observed misclassification of occupational illnesses as injuries. This phenomenon illustrates important inconsistencies in the OSHA 200 reporting system. Specifically, all occupational illnesses must be reported under the system, regardless of severity, whereas occupational injuries are reported only if they meet specific criteria reflecting severity. Furthermore, classification of illness or injury depends on the exposure leading to the condition. If the exposure was "instantaneous" (a time period defined only by examples of a fall or blow in BLS reporting guidelines), the condition is viewed as an injury. Conditions resulting from all other (i.e., noninstantaneous) exposures are considered illnesses.

Thus, classification of injury and illness in the OSHA system is based on duration of exposure instead of on a biological index such as the nature or severity of the medical condition. Persons unfamiliar with this classification system might use a more biologic and intuitive approach and classify certain illnesses, such as repetitive trauma disorders or chemical burns, as injuries. In addition, the duration of exposure may not be precisely known, and reporting completenes will depend on the interpretation of incomplete or equivocal exposure information by the companies' reporting personnel. However, the majority of underreported or misclassified cases reported here were not equivocal; underreporting appeared due to inconsistent use of published reporting criteria addressing the clinical features of the case.

In spite of the limitations of this study, we have made several valuable observations on which to base specific recommendations. The OSHA data require company personnel at each facility to make case evaluation and classification decisions. Within an industry, the large number of facilities contributing cases introduces the potential of variable reporting practices between facilities, contributing to variability in the quality of the data. In contrast, the coding of clinical data entering the SDS is performed by a small number of trained personnel in a central state office. Our findings indicate that this practice is associated with high reliability of coding for clinical data. It would be impractical to submit all work-related cases to a central office for determination of reportability, and this responsibility is likely to remain at the level of designated personnel at each facility. Reporting practices may be improved and made more uniform by focusing educational measures on these personnel. Education should emphasize recognition of occupational illnesses, for which underreporting was most significant in this study.

We recommend that recording personnel use a formal, stepwise process that forces response to the following pertinent questions to determine reportability of occupational conditions.

- Was the exposure instantaneous (e.g., a fall or a blow)? All cases for which the exposure was not instantaneous are reportable as occupational illnesses. Cases for which the exposure was instantaneous are injuries; the following additional questions must be addressed to evaluate their reportability.
- Was medical treatment other than first aid required, as defined in BLS reporting guidelines?
- Was restriction of work or motion involved that interfered with normal work activities?
- Was there loss of consciousness?
- Was the employee transferred or terminated due to the condition?

If the answer to any of the last four questions is affirmative, the injury is reportable. Regular review of selected cases would help assure consistency and validity of results.

We also recommend that studies evaluating reporting practices be conducted in other industrial sectors. These studies would expand the findings of the investigation reported here and provide a more broadly based picture of the accuracy of national occupational injury and illness data based on the OSHA 200 log. Studies focused on specific occupational conditions should also be undertaken to evaluate the completeness and accuracy of reporting for the OSHA 200 system using independent data sources, such as cancer registries, workers' compensation records, hospital discharge data bases,[15] Poison Control Centers,[14] and occupational health clinics.[16] Accurate surveillance methodology is especially important for occupational illnesses, which are poorly captured by the OSHA 200 system.[13] Finally, case reportability criteria, currently constrained by the Occupational Safety and Health Act, should be reviewed and revised to conform to biological criteria rather than to duration of exposure. ☐

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Trends in the Content and Use of Oral Contraceptives in the United States, 1964–88

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ABSTRACT

Drug marketing and physician survey data were used to examine trends in the use and hormonal content of oral contraceptives in the United States between 1964 and 1988. Retail prescriptions for oral contraceptives peaked at approximately 68 million in 1973 and have remained between 50 million and 60 million since 1981. Despite this relative consistency in the number of prescriptions, physician "mentions" of oral contraceptives have increased by approximately 75 percent. This increase may reflect closer monitoring of women on oral contraceptives. Use of multiphasic formulations has steadily risen, accounting for 37 percent of the oral contraceptive prescriptions in 1988. Mean estrogen and progestin doses in all types of formulations have steadily declined. A change in the type of estrogen and progestin used in preparations has coincided with this decline in dose. The association between age and use of high-dose formulations seen in the past was no longer evident in 1988. The data demonstrate that oral contraceptive formulations in wide use today differ in hormone content from those of the past, when most of the major studies addressing the risks associated with oral contraceptive use were completed. There is therefore a need to determine the risks and long-term effects associated with these newer formulations. (*Am J Public Health* 1991; 81:90–98)

Introduction

Since oral contraceptives were introduced three decades ago, 56 brands representing 33 unique formulations have been marketed in the United States (see Appendix). Most of these preparations have contained a constant amount of estrogen and progestin (*monophasic* combinations); other types are *sequential*, progestin only ("*minipills*"), and *multiphasic* formulations.

Sequential formulations contained estrogen alone during the first 14 to 16 days of use each cycle followed by an estrogen-progestin combination during the last five to seven days of use. These pills are no longer marketed but were available from 1965 to 1976. Minipills were first introduced in 1972 and have never accounted for more than a fraction of a percent of retail oral contraceptive prescriptions. Multiphasic formulations contain varying estrogen and/or progestin amounts during the cycle and were first introduced in 1982 in an attempt to emulate hormone fluctuations of the menstrual cycle and to lower overall hormone doses.

In considering the beneficial and adverse effects associated with specific oral contraceptive formulations, one must consider the types and doses of estrogen and progestin they contain. Two types of estrogen and nine synthetic progestins have been used in oral contraceptives. The two estrogens, ethinyl estradiol and mestranol, have identical biological effects. Some studies, mostly animal, suggest that on a weight-by-weight basis, ethinyl estradiol is more potent than mestranol in suppressing ovulation, since mestranol must first be converted in the body to ethinyl estradiol.[1–3] In the human body, however, differences in potency between ethinyl estradiol and mestranol do not appear to be important.[4] Progestins contained in oral contraceptives differ by orders of magnitude in potency and may demonstrate varying degrees of androgenic, estrogenic, antiestrogenic, and other metabolic effects.[5–7]

This paper reports changes in the use of oral contraceptive formulations in the United States from 1964 to 1988. It also examines the relationship between formulation type and the age of users in the period 1980–88. An understanding of these trends is important to better interpret results of previous studies and to plan future studies that seek to clarify the relationship between oral contraceptive use and its potential to cause adverse as well as beneficial effects.

Methods

Sources of Data

Data from two pharmaceutical marketing research data bases produced by IMS America, Ltd. (Plymouth Meeting, PA), were used to examine trends in oral contraceptive use and prescribing. The National Prescription Audit (NPA) was used to provide information on the number or oral contraceptive prescriptions

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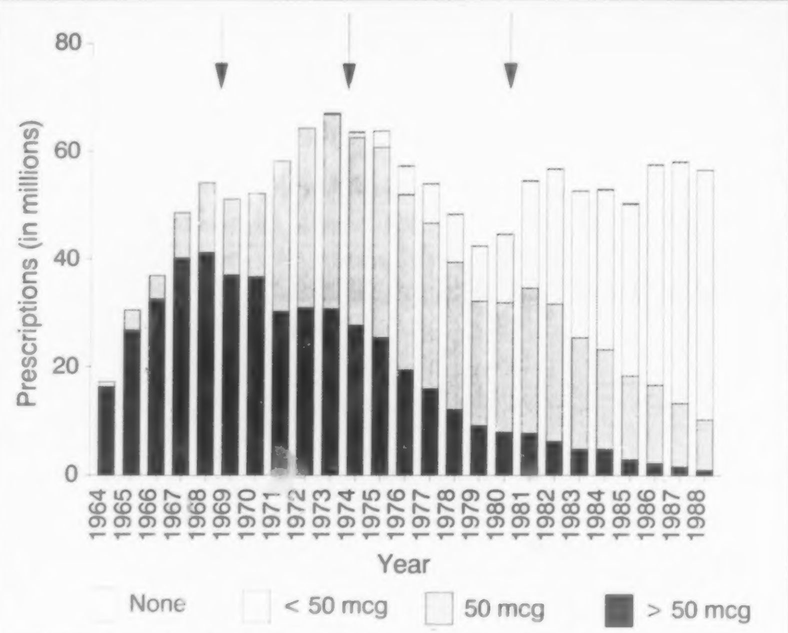

FIGURE 1—Number of Retail Oral Contraceptive Prescriptions by Estrogen Dose, 1964–1988, United States

Arrows indicate points at which changes in data collection methods occurred.

dispensed by retail pharmacies in the contiguous United States. Age-related trends in utilization were based on the National Disease and Therapeutic Index (NDTI) for the years 1980, 1984, and 1988.

The NPA derives its information from chain and independently owned retail pharmacies in the contiguous United States. Other dispensing outlets such as mail order pharmacies, supermarket pharmacies, and clinics are not included. IMS America estimates that retail pharmacies fill approximately 90 percent of prescriptions in the United States. This proportion, however, may not apply to oral contraceptive prescriptions, because approximately one in four women who use reversible forms of contraception rely on publicly funded clinics for care.[8] We were therefore unable to estimate the percentage of oral contraceptive prescriptions that is covered by this study. Nonetheless, previous studies have suggested that trends in oral contraceptive use reported by NPA accurately reflect trends in the general population.[9,10]

From 1981 to 1987, IMS audited all new and refilled prescriptions dispensed at 1,200 computerized pharmacies. This sample was expanded to 2,500 sites in 1987. From 1974 to 1980, data were derived from a representative sample of 800 pharmacies, each of which was audited for two days per month. From 1970 to 1974, 400 pharmacies were audited for four days per month. Prior to 1970, 200 pharmacies reported every fifth prescription filled during the first and third week of each month. Although these changes in methodology may create artifacts at points of change, trends within intervals are unaffected.

Information on the NPA sampling frame is updated annually. Sampled pharmacies represent the universe of retail pharmacies in terms of ownership type, size, and geographic region. Using sampling fractions based on these factors, the number of retail prescriptions dispensed nationwide was estimated.

The NDTI, used to provide information on physician usage patterns of oral contraceptives in relation to age of patients, is based on a sample of 2,130 physicians per quarter recruited from the membership rolls of the American Medical Association and the American Osteopathic Association. The NDTI sample is selected from four geographic regions and 19 specialties, and it is estimated that its sampling universe includes the prescribing practices of 270,827 office-based physicians, but not the prescribing of 51,112 other clinic- and hospital-based physicians. Projection factors derived from the number of physician-days for each of the defined geographic and specialty strata are used to project national estimates.

NDTI-audited physicians are asked to report on each private patient seen or contacted by phone during a specified 48-hour period. Physicians provide information on patient demographics, diagnoses, and treatments for each diagnosis rendered. By convention, the term "mention" is used to denote each drug considered or given during a patient contact. Drugs that are mentioned during a physician-patient contact may reach the patient through prescription, hospital order, provision of samples, or administration or dispensing in the office. It is worthwhile to note that mention of a drug does not necessarily mean that a prescription was issued. Projection factors derived from the number of physician-days in the sample relative to that of the universe for each of the geographically and specialty-defined strata are used to estimate national usage patterns.

Classification of Oral Contraceptives

Formulations were classified by type (monophasic, multiphasic, sequential, minipill), estrogen dose, estrogen contained (mestranol, ethinyl estradiol, none), progestin dose, and progestin contained. Progestins were grouped as follows: norethindrone, ethynodiol diacetate and norethindrone acetate (norethindrone derivative), norethynodrel (oral contraceptives containing norethynodrel were no longer marketed for contraception after October 1988) norgestrel, levonorgestrel, and progestins no longer used in current oral contraceptive formulations (dimethisterone, chlormadinone, medroxyprogesterone acetate). Norethindrone, ethynodiol diacetate, and norethindrone acetate were grouped because previous studies have suggested that these progestins demonstrate similar biological activity and are equally potent on a weight-by-weight basis.[11] We evaluated dose trends by examining both the percentages of retail prescriptions that contained more than 50 μg, 50 μg, and less than 50 μg of estrogen and the mean estrogen and progestin doses of oral contraceptive.

Results

As depicted in Figure 1, total prescriptions rose between 1964 and 1968. After a small decline in 1969, the annual number of prescriptions increased, peaking in 1973. From 1974 to 1979, the number of prescriptions declined steadily. The

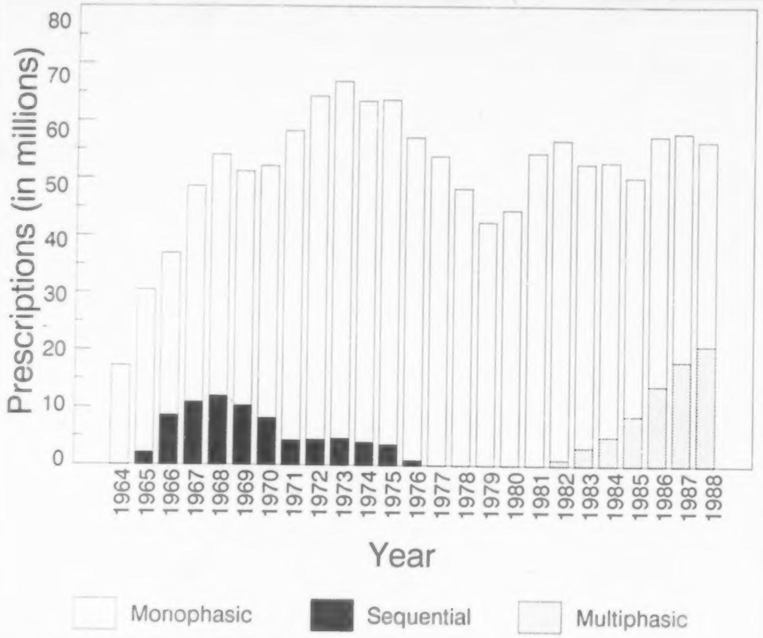

FIGURE 2—Number of Retail Oral Contraceptive Prescriptions by Formulation Type, 1964–1988, United States

TABLE 1—Mean Progestin and Estrogen Dose in Prescriptions for Every Fourth Year between 1964 and 1988, United States

	Progestins				Estrogens	
Year	Norethindrone Group mg	Norgestrel mg	Norethynodrel mg	Levonorgestrel mg	Ethinyl Estradiol μg	Mestranol μg
1964	2.52	—	5.18	—	50[a]	91
1968	1.50	0.50	3.71	—	70	89
1972	1.22	0.50	3.93	—	56	82
1976	1.14	0.46	3.77	—	47	76
1980	1.01	0.41	3.92	—	41	66
1984	0.97	0.37	3.27	0.15	37	62
1988	0.89	0.35	2.73	0.11	35	57

[a] There were only two formulations containing ethinyl estradiol in 1964 (Norlestrin 2.5 mg and Provest), each of which contained 50 μg ethinyl estradiol.

SOURCE: National Prescription Audit, IMS America, Ltd., Plymouth Meeting, PA.

apparent increase in the number of dispensed prescriptions that is seen between 1980 and 1981 could be an artifact of a change in data collection methods that coincided with these dates. Since 1981, the number of prescriptions has remained between 51 million and 58 million.

Prescriptions demonstrate a distinct trend toward use of formulations that contain less than 50 μg of estrogen per tablet (Figure 1). In 1968, fewer than 1 percent of the estimated 54 million retail prescriptions for oral contraceptives were for formulations containing less than 50 μg of estrogen, whereas in 1988 approximately 82 percent of the approximately 57 million retail prescriptions were for formulations with less than 50 μg of estrogen. Retail prescriptions for sequential formulations (no longer marketed) reached their maximum in 1968 (Figure 2). The number of prescriptions for multiphasic formulations steadily increased after they were introduced in 1982, accounting for 37 percent of all retail oral contraceptive prescriptions in 1988.

Mean estrogen and progestin doses have declined over time (Table 1). Since 1981, ethinyl estradiol has become the most common estrogen (Figure 3). Oral contraceptives containing norethindrone derivatives increased market share during the 1960s and have remained fairly constant; they have been included in approximately 65 percent of prescriptions since 1970 (Figure 4). The recent increase in levonorgestrel from less than 1 percent of the market in 1982 to 19 percent in 1988 is attributable to the increased use of two triphasic preparations containing this form of progestin. At the same time, the use of norgestrel declined from 32 percent of the market in 1983 to 16 percent of the market in 1988.

Oral contraceptive mentions by office-based physicians have increased from 1980 to 1988 by 75 percent (13,501 × 10^3 mentions in 1988; 7,716 × 10^3 mentions in 1980: Table 2). The proportion of within-year mentions in the 15- to 24-year-old group has decreased relative to that of the 25- to 34-year-old group. In 1980, 15- to 24-year-old women accounted for 57 percent of oral contraceptive mentions and 25- to 34-year-old women accounted for 37 percent of mentions. In 1988, these figures were 48 percent and 45 percent, respectively. Mentions in the 35- to 44-year-old group accounted for 6 to 7 percent of mentions during this interval.

Mentions for multiphasic formulations increased between 1984 and 1988 (Table 2). In 1984, 15 percent of mentions were for multiphasic formulations. In 1988, 40 percent of mentions were for multiphasics. The largest use of multiphasics occurred in the 15- to 24-year-old age group.

The mean estrogen dose of mentions was directly associated with age of users in 1980 and 1984 (Table 3). The association between age and ethinyl estradiol dose was no longer evident in 1988; the average ethinyl estradiol dose in mentions was 35 μg, irrespective of age. The association between age and mestranol dose has weakened. In 1988, the mean mestranol dose for 15- to 24-year-old women was 56 μg, for 25- to 34-year-old women it was 54 μg, and for 35- to 44-year-old women it was 63 μg.

In 1980 and 1984, 35- to 44-year-old oral contraceptive users were more likely to use mestranol-containing formulations than their younger counterparts. By 1988, only 8 percent of mentions in 35- to 44-year-old women were for mestranol-containing formulations. This figure compares with 15 percent in 25- to 34-year-old women, and 6 percent in 15- to 24-year-old women.

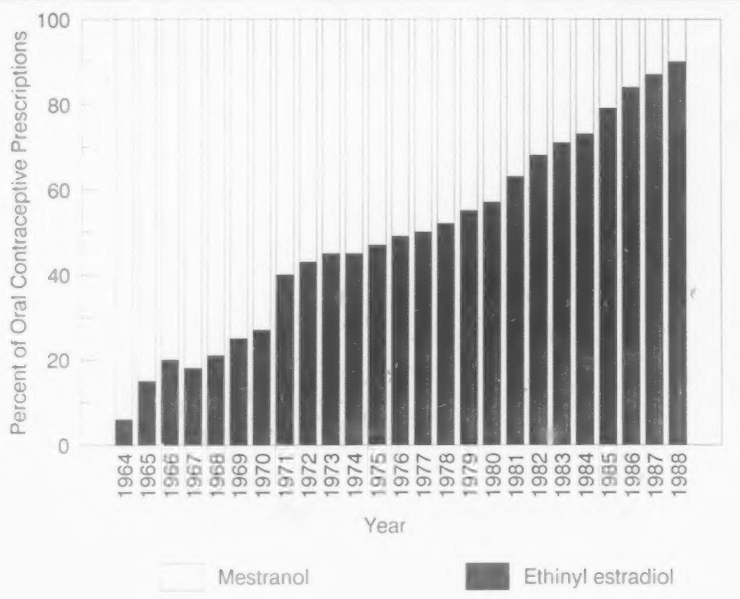

FIGURE 3—Percent of Dispensed Prescriptions by Estrogen Type, United States

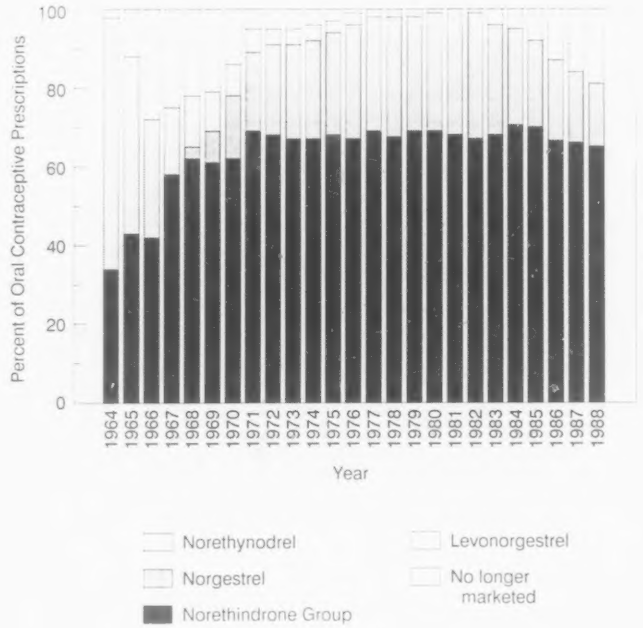

FIGURE 4—Percent of Dispensed Prescriptions by Progestin Type, United States

Discussion

Data presented in this paper pertain to office-based physicians and exclude public clinics as a source of oral contraceptives. In addition, NPA data reflect the number of dispensed retail prescriptions but do not contain information on the number of cycles covered by each prescription. Therefore, NPA data cannot be used to estimate the prevalence of oral contraceptive use in the population. An additional limitation is that there has been no adjustment for change in the number of women of childbearing potential in the population. Despite these limitations, NPA and NDTI data are useful for monitoring large changes in the use of various oral contraceptive formulations over time.

Retail prescription data suggest that overall use of oral contraceptives has been fairly stable since 1981. NPA projections suggest a modest 2.4 percent increase from 1982 to 1987, compared with an 18.5 percent increase in the prevalence of oral contraceptive use reported by Forrest and Fordyce.[12] (Forrest and Fordyce report the percent distribution of women using oral contraceptives increased from 27 percent in 1982 to 32 percent in 1987.) However, neither of these estimates allows for sampling variation, and if we were to estimate the percent change in NPA from 1983 to 1987, a 10.3 percent increase would be noted. This inference, of course, is based on the assumption that both estimates are representative and unbiased and that the average duration of NPA prescription has remained constant over the time interval. However, direct comparisons between NPA projections and those offered by Forrest and Fordyce may not be justifiable, because the former refer to the number of retail prescriptions and the latter are based on self-reported use. Thus, these data are not fully comparable.

Although the number of dispensed retail prescriptions has been relatively stable, the number of NDTI mentions has increased by 75 percent. This apparent inconsistency may be the result of changes in survey methodology, or survey inaccuracy, or it may reflect a change in physician care of patients taking oral contraceptives. We speculate that the observed increase in mentions with no large increase in the number of dispensed prescriptions could be indicative of closer monitoring of women on oral contraceptives.[13]

The impact of the steady increase in the use of multiphasic formulations is unclear because the risks and benefits associated with them compared with other low-dose formulations are largely unknown. Although one article reported a series of functional ovarian cysts in women using multiphasic oral contraceptives,[14] previous studies have demonstrated a reduction in the incidence of

TABLE 2—Number of Mentions of Oral Contraceptives (In Thousands) with Percent of Mentions That Were for Multiphasic Formulations, by Age for 1980, 1984, and 1988, United States

	1980		1984		1988	
Age (yrs)	Total (%)[a]	Multiphasics (%)[b]	Total (%)[a]	Multiphasics (%)[b]	Total (%)[a]	Multiphasics (%)[b]
15–24	4,412 (57)	NA	5,878 (52)	1,009 (17)	6,475 (48)	3,074 (48)
25–34	2,859 (37)	NA	4,741 (42)	636 (13)	6,147 (45)	2,039 (33)
35–44	445 (6)	NA	577 (5)	43 (7)	869 (7)	272 (31)
15–44	7,716 (100)	NA	11,196 (100)	1,688 (15)	13,501 (100)	5,385 (40)

[a] Percent of total oral contraceptive mentions.
[b] Percent of within-age mentions that were for multiphasic formulations.
NA = Not Available

SOURCE: NDTI, IMS America, Ltd., Plymouth Meeting, PA.

TABLE 3—Mean Estrogen Dose of Mentions by Estrogen Type and Age of Patients, United States, 1980, 1984, and 1988

	1980			1984			1988		
Age (yrs)	Mean EE Dose µg	Mean ME Dose µg	% of Mentions Containing ME	Mean EE Dose µg	Mean ME Dose µg	% of Mentions Containing ME	Mean EE Dose µg	Mean ME Dose µm	% of Mentions Containing ME
15–24	39	61	31	35	58	17	35	56	6
25–34	40	64	41	37	61	23	35	54	15
35–44	43	69	53	41	69	22	35	63	8
15–44	40	63	46	36	60	80	35	55	10

EE = ethinyl estradiol;
ME = mestranol

SOURCE: NDTI, IMS America, Ltd., Plymouth Meeting, PA.

functional ovarian cysts in women using high- and intermediate-dose formulations.[15,16] No study to date has measured the risk of functional ovarian cyst formation in users of multiphasic formulations relative to nonusers or to women using other low-dose formulations. Gaspard and Lepot have reported no significant difference in follicular development between users of a low-dose monophasic formulation and its triphasic analog.[17]

Progestin doses have been declining over time. However, all progestins are not equipotent on a milligram-per-milligram basis. For example, previous studies suggest that norgestrel is 5 to 10 times as potent as norethindrone, and levonorgestrel is 10 to 20 times as potent as norethindrone.[10] Using these factors to adjust mean dose, today's norgestrel and levonorgestrel doses are comparable, in terms of potency, to norethindrone doses of the 1960s and 1970s (Table 1). In addition, norgestrel and levonorgestrel may demonstrate more androgenic activity than norethindrone derivatives.[18] Changes in oral contraceptive progestins may have effects on ratios of high- to low-density lipoproteins,[19] glucose tolerance, blood pressure,[20] and the risks of vascular disease,[21–23] benign breast disease,[24] and perhaps even breast cancer.[25]

A decline in the mean estrogen dose contained in formulations was observed. Because the intravascular coagulation and the activity of several clotting factors appear to be estrogen dose dependent,[26–28] this decline has probably resulted in a decline in the incidence of adverse cardiovascular events associated with oral contraceptive use.[29–31]

The correlation between age and high-dose estrogen oral contraceptives seen in the past[32] has almost disappeared. For the most part, women of older reproductive age who choose to use oral contraceptives have taken advantage of the risk reductions associated with low-dose estrogen formulations.

Our data confirm that the oral contraceptives of today contain less hormone than those of the past, when most of the major studies that addressed the risks associated with oral contraceptive uses were completed. Some of these previously defined risks may not necessarily be associated with today's formulations. Additional risks, if any, are not fully known. There is therefore a need to determine the acute and long-term effects associated with these newer formulations. ☐

Acknowledgments

The views in this paper are those of the authors and not necessarily those of the Food and Drug Administration.

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APPENDIX— Hormonal Content of Oral Contraceptives Marketed in the United States, 1964–88

Brand	Years	Progestin	mg^a	Estrogen	μg^a
Monophasics					
Brevicon	1975–88	NEI	0.5	EE	35
Demulen 1/35	1982–88	ETH	1.0	EE	35
Demulen 1/50	1970–88	ETH	1.0	EE	50
Enovid 10 MG	1964–87	NEY	10.0	ME	150
Enovid 5 MG	1964–88	NEY	5.0	ME	75
Enovid-E	1964–88	NEY	2.5	ME	100
Genora 0.5/35	1988–88	NEI	0.5	EE	35
Genora 1/35	1987–88	NEI	1.0	EE	35
Genora 1/50	1987–88	NEI	1.0	ME	50
Gynex 0.5/35	1988	NEI	0.5	EE	35
Gynex 1/35	1987–88	NEI	1.0	EE	35
Levlen	1986–88	LEV	0.15	EE	30
Loestrin 1.5/30	1973–88	NEA	1.5	EE	30
Loestrin 1/20	1973–88	NEA	1.0	EE	20
Lo/Ovral	1975–88	NOR	0.3	EE	30
Modicon	1975–88	NEI	0.5	EE	35
Nelova 0.5/35	1988–88	NEI	0.5	EE	35
Nelova 1/35	1987–88	NEI	1.0	EE	35
Nelova 1/50	1988–88	NEI	1.0	EE	50
Nordette	1982–88	LEV	0.15	EE	30
Norethin 1-35E	1988–88	NEI	1.0	EE	35
Norethin 1-50E	1988–88	NEI	1.0	EE	50
Norinyl 1/35	1980–88	NEI	1.0	EE	35
Norinyl 1/50	1967–88	NEI	1.0	ME	50
Norinyl 1/80	1969–88	NEI	1.0	ME	80
Norinyl 2 mg	1964–88	NEI	2.0	ME	100
Norlestrin 1 mg	1967–88	NEA	1.0	EE	50
Norlestrin 2.5 mg	1964–88	NEA	2.5	EE	50
N.E.E. 1/35	1988–88	NEI	1.0	EE	35

(Continued)

APPENDIX—Continued

Brand	Years	Progestin	mg[a]	Estrogen	µg[a]
Ortho-Novum 10 mg	1964–80	NEI	10.0	ME	60
Ortho-Novum 1/35	1980–88	NEI	1.0	EE	35
Ortho-Novum 1/50	1967–88	NEI	1.0	ME	50
Ortho-Novum 1/80	1968–88	NEI	1.0	ME	80
Ortho-Novum 2 mg	1964–88	NEI	2.0	ME	100
Ovcon-35	1976–88	NEI	0.4	EE	35
Ovcon-50	1976–88	NEI	1.0	EE	50
Ovral	1968–88	NOR	0.5	EE	50
Ovulen	1968–88	ETH	1.0	ME	100
Provest	1964–69	MED	10.0	EE	50
Zorane 1/20	1974–77	NEA	1.0	EE	20
Zorane 1.5/30	1974–79	NEA	1.5	EE	30
Zorane 1/50	1973–77	NEA	1.0	EE	50
Sequential Formulations					
C-Quens	1965–72	CHL	2.0	ME	80
Noriday	1968–69	NEI	1.0	ME	50
Norquen	1967–76	NEI	2.0	ME	80
Oracon	1965–76	DIM	25.0	EE	100
Ortho-Novum SQ	1967–76	NEI	2.0	ME	80
Progestin Only Formulations					
Micronor	1973–88	NEI	0.35	—	0
Nor-Q.D.	1973–88	NEI	0.35	—	0
Ovrette	1974–86	NOR	0.075	—	0
Multiphasic Formulations					
Nelova 10/11	1988	NEI	0.76	EE	35
Ortho-Novum 10/11	1982–88	NEI	0.76	EE	35
Ortho-Novum7/7/7	1984–88	NEI	0.75	EE	35
Triphasil	1984–88	LEV	0.09	EE	32
Tri-Levlen	1986–88	LEV	0.09	EE	40
Tri-Norinyl	1984–88	NEI	0.71	EE	35

[a] Average dose is reported for multiphasic formulations.

CHL = chlormadinone;
DIM = dimethisterone;
ETH = ethynodiol diacetate;
LEV = levonorgestrel;
MED = medroxyprogesterone acetate;
NEA = norethindrone acetate;
NEI = norethindrone;
NEY = norethynodrel;
NOR = norgestrel
EE = ethinyl estradiol;
ME = mestranol

The Status of Restrictive Smoking Policies: A Survey of Medical Schools in the United States and Canada

Frances A. Stillman, EdD, and Diane M. Becker, ScD, MPH

ABSTRACT

All schools of medicine in the United States (N = 128) and Canada (N = 16) were surveyed by telephone to determine if they had instituted policies to restrict smoking. Some policy restricting smoking was reported by 80.56 percent of US schools (N = 103) and by 93.8 percent of Canadian schools (N = 15). However, only 52.3 percent of US (N = 67) and 56.3 percent of Canadian medical schools (N = 9) indicated they had formal written policy statements. Only 13 percent of US schools and 19 percent of Canadian schools had banned smoking totally. (*Am J Public Health* 1991; 81:101–102)

Introduction

Systematic investigation of medical schools' smoking policies have not appeared in the public health literature on smoking policy implementation. This study was designed to determine the extent to which medical schools in the United States and Canada have responded to escalating efforts to eliminate smoking from health care training settings.[1-6]

Methods

Designated representatives from all 128 schools of medicine in the United States accredited by the Association of American Medical Colleges and all 16 schools of medicine in Canada with associative membership status[7] were interviewed by telephone by means of a standardized survey instrument. Surveys were directed to the deans' office and other administrative divisions responsible for regulating smoking for faculty, staff, and students. Data were obtained on reported smoking policies and the implementation process. Each institution that reported a definite smoking policy was asked to provide a copy of the written policy for review. Policy documents were reviewed independently by two raters to ascertain the content and level of restrictiveness of the policy. Interrater agreement was 100 percent.

The policies were classified as "common courtesy," designated no-smoking, designated smoking, total ban, or a total ban plus employee-student restrictions (i.e., on hiring practices, admitting smoking students to the medical school, or both).

A policy classified as common courtesy was one in which the prevailing trend was to seek the preference of others in the environment to determine if there were objections to smoking. Generally smoking would be discouraged only if complaints were raised.

A policy classified as designated no-smoking was one in which smoking was prohibited in designated areas (i.e., lecture halls, labs, and classrooms) but permitted in all other areas.

A policy classified as designated smoking prohibited smoking throughout the environment except in varying numbers of indoor designated areas.

A policy classified as a total ban was one in which smoking was prohibited in all of the interior environment; and no areas for smoking were provided.

A policy classified as a total ban plus employee-student restrictions consisted of a total ban on smoking and a decision not to admit students who smoked to the medical school or hire staff who smoked.

Results

The rate of response to the telephone survey was 100 percent. Based on self-reported survey data, 80.5 percent (N = 103) of US schools and 93.8 percent of Canadian schools (N = 15) indicated the presence of a smoking policy. The majority of schools reported policies of the designated no-smoking type.

Only 52 percent (N = 67) of US and 56 percent (N = 9) of Canadian medical schools that reported having a smoking policy acknowledged the existence of written policy documents. Only two US schools reported having the most restrictive type of policy, which both banned smoking and restricted hiring of employees and admittance of students to nonsmokers. Both schools did so based on religious reasons. The majority of US schools (83 percent) and Canadian schools (75 percent) prohibited the sale of cigarettes on their campuses.

Figure 1 summarizes the percentage of schools with a formal written policy statement grouped according to policy type. All schools in the US and Canada that reported having formal written policies sent copies of their written policy statements. Of the 21 percent of US

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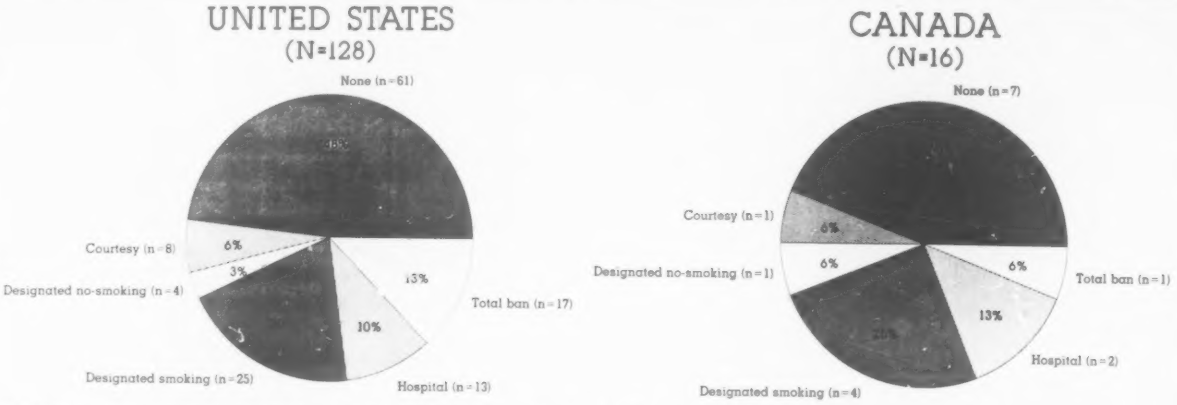

FIGURE 1—Percentage of medical schools with formal smoking policies, by type of policy

schools (N = 27) that reported the existence of a total ban, only 13 percent (N = 17) had formalized the ban into written format. The additional category of "hospital policy" denoted medical schools that had policies that affected only their associated hospitals but not their medical school environment.

Table 1 provides details about the distribution of medical schools with a smoking policy by region based on the written policy statements submitted. The eastern US and the Great Lakes region of Canada had the highest percentage of schools with policies.

While 52 percent of US schools reported providing smoking cessation assistance to students or staff before the policy was implemented, only 36 percent continued to provide some such assistance once restrictions were enforced. The type of assistance provided included formal on-site smoking cessation programs, self-help materials, health screenings, cash incentives for quitting, and referral to community-based smoking cessation programs. In Canada, 53 percent of medical schools provided assistance during the implementation phase of the no-smoking policy.

Discussion

Medical schools with formal policies totally banning or markedly restricting smoking remain in the minority. While the majority of medical schools reported the presence of some smoking policy, barely half of all schools had written policies. The finding that only a relatively low number of schools had made any formal commitment to smoking reduction is surprising given the escalating public interest in smoking and health and reports of successful smoke-free policy implementations in health-care settings.[8,9] By prohibiting smoking, medical schools can make a definitive health statement and act as models of healthy behavior. □

TABLE 1—Percentage of US and Canadian Medical Schools with Formal Written Smoking Policies, by Region

Region	Total Number of Schools	School with Smoking Policy N	%
United States	**128**	**67**	**52.3**
West	14	8	57.1
Southwest	11	5	45.5
Midwest	10	5	50.0
Great Lakes	22	11	50.0
South	31	11	35.4
East	36	27	75.0
Other	4	0	0.0
Canada	**16**	**9**	**56.3**
West	5	2	20.0
Great Lakes	5	5	100.0
East	6	2	33.3

Note: U.S. regions consist of AK, CA, CO, ID, MT, NV, OR, UT, WA, and WY in the West; AZ, NM, OK, and TX in the Southwest; IA, IL, MI, MN, OH, and WI in the Great Lakes; IA, KS, MO, ND, NE, and SD in the Midwest; AR, AL, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV in the South; and CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT in the East. Other: HI, PR.

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Measurement of Attitudes and Behaviors in Public Health Surveys

François Béland, PhD, Brigitte Maheux, MD, PhD, and Jean Lambert, PhD

ABSTRACT

We divided 900 general practitioners into two groups: one group received a questionnaire measuring both attitudes and behaviors toward preventive aspects of medical care, while the other received two separate questionnaires—one measuring behaviors, and one measuring attitudes. Response rates of the two groups were similar. Respondents in the first group retrieved their answer to the attitudinal items when responding to behavioral items, increasing the correlations between attitudes and behaviors by an average of .147 as compared to the second group; hence the second procedure was preferable. (*Am J Public Health* 1991; 81:103–105)

Introduction

Attitudes and behaviors are salient factors in most of the current public health issues. Most studies measure attitudes and behaviors using a set of items included in a single closed-form questionnaire. Inasmuch as attitudes and behaviors toward the same act are examined, the wording of the items and the response formats should be nearly identical to each other.[1–13] Feldman and Lynch[14] implied that a response to a question is likely to be retrieved as a basis for a subsequent response if they are presented consecutively in one questionnaire. Using similarly worded items to measure attitudes and behaviors compounds the problem. In the present paper we address the question of whether attitudes and behaviors can be measured accurately with a single questionnaire.

Methods

We randomly divided a sample of 900 general practitioners into two groups. One group (A) received a questionnaire in which both their attitudes and behaviors were assessed. The other group (B) received a questionnaire measuring behaviors; on receipt of that completed questionnaire, we mailed them a second one which pertained to their attitudes.

The response rate for group A was 64.3 percent. The response rate for group B was 73.2 percent. Ninety-two percent of the physicians in group B who answered the first questionnaire also completed the second questionnaire.

Twenty-one attitudinal items based on a series of questions (see Appendix) and 21 similarly worded behavioral items were presented to physicians on a six-point rating scale. They measured practices that physicians considered appropriate to perform (attitudes) and those which they claimed to perform (behaviors) in three clinical situations:

- the extent of information that a physician should provide to chronically ill patients about their illness;
- the extent to which a physician should promote non-smoking behavior to patients that consult for reasons other than smoking problems;
- the extent to which a physician should discuss weight with an obese patient consulting for reasons other than obesity.

The items measuring attitudes and behaviors were worded in the same manner.[14] Systematic biases in measuring attitudes and behaviors were assessed by comparing the correlation coefficients between attitudes and behaviors in the two groups of physicians.

The correlation coefficients were transformed into z-scores, using the Fisher Transformation, to test for the difference[15] between the association of attitudes and behaviors in the two groups of respondents. A total of 21 tests were performed for each of the comparisons between two groups. A P-plot procedure was used[16] to estimate the number N of true null hypotheses. The estimate of N was then used to obtain an overall α-level which was less conservative than the usual Bonferonni level. The value of N was 6 in this study, thus the significant level was set at $.05/6 = .008$.

Results

Eight correlations between attitudes and behaviors were different in the two groups at the 0.008 level (Table 1). Pearson's correlation coefficients between attitudes and behaviors were larger by an average of .147 in the group who received one questionnaire than in the group who answered two separate questionnaires.

Some differences in the item variances emerged (data not shown). Because a correlation coefficient is obtained from the division of the covariance with the variances, a small difference in variances can produce large differences in the estimated correlation coefficient. To test whether the differences in the correlations were due to differences in the variances in

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TABLE 1—Correlations of Attitudinal and Behavioral Items

Items	Subsamples		p-values
	One Questionnaire	Two Questionnaires	
Item 1	.502	.352	.039
Item 2	.349	.274	.352
Item 3	.677	.329	.000*
Item 4	.571	.382	.006*
Item 5	.699	.536	.002*
Item 6	.538	.576	.540
Item 7	.594	.482	.028
Item 8	.533	.352	.011
Item 9	.416	.373	.566
Item 10	.366	.317	.546
Item 11	.407	.223	.025
Item 12	.410	.339	.340
Item 13	.693	.468	.000*
Item 14	.470	.386	.248
Item 15	.645	.446	.001*
Item 16	.643	.404	.000*
Item 17	.691	.625	.193
Item 18	.662	.575	.117
Item 19	.655	.436	.000*
Item 20	.642	.365	.000*
Item 21	.472	.319	.041
Mean correlation	.554	.407	

*Different at $\alpha = .05/6 = 0.008$

the items, the 21 variance-covariance matrices for attitudinal and behavioral items of the two groups were compared using the Joreskög procedure.[17] Only four covariances out of 21 were significantly different between the two groups, while 14 variances were significantly different. As a consequence, the differences in the estimated variances had an effect on the estimate of the correlations.

Discussion

The results of our study showed that respondents to a questionnaire, wherein attitudinal items are followed by similarly worded behavioral items, retrieved their answer to the attitudinal items in order to answer questions on behavioral items. Pearsons correlations between attitudes and behaviors were larger by an average of .147 in the group who received one questionnaire than in the group who answered two separate questionnaires.

Some of the differences between the correlations were accounted for by the variances. Thus, fewer covariances than correlations were affected by the data collecting procedures. However, because there were significant differences in the means on the behavioral items between the two groups (table not shown) and because the computation of the covariances depends on the means, the estimates of the covariances were also biased.

Psychometric methods are used in attitudinal and behavioral scale testing. More often than not, researchers use a correlation matrix rather than a covariance matrix when testing for reliability and studying the validity of their scales. Thus, using one or two questionnaires would yield very different reliability coefficients.

The data from this study suggest that when similarly worded items are used to test for both attitudes and behaviors, two questionnaires are required. Nevertheless, the effect of features of questionnaire design should be tested before such a radical conclusion becomes conventional practice. For example, the set of behavioral items was listed immediately after the set of attitudinal items in this study. Had we introduced questions on other topics between the two sets of questions the response bias might have been lowered. Also, it may be possible to use different items to measure both or to use a set of similarly worded and a set of differently worded items. ☐

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APPENDIX—The 21 Attitudinal Items

Items	Questions
Q1	**The general practitioner is often called upon to treat patients suffering from chronic pathologies. When a physician treats a patient suffering from high blood pressure, diabetes or arthritis, for example, should he inform him about:** ITEM 1 The medical name of the illness ITEM 2 The nature of the illness (e.g. chronicity, diseased organ) ITEM 3 The cause of the illness ITEM 4 The probable evolution of the illness, if treated ITEM 5 The name of the medication prescribed ITEM 6 The type of medication prescribed (e.g. diuretics, hypotensor) ITEM 7 The respective role of each medication
Q2	**Should the physician do the following things with the types of patients outlined above?** ITEM 8 Write a memorandum of the main items of information for the patient ITEM 9 Give the patient written documentation on his/her illness ITEM 10 Review with the patient at the next visit, the information he/she received from you previously ITEM 11 Give the patient the names of resources to contact for additional information on his/her illness (e.g. dietitian, association, etc.) ITEM 12 Inform the patient about the good popular books published on his/her health problem
Q3	**Finally, should the physician do the following things according to you?** ITEM 13 Try to find out about the patient's social environment ITEM 14 Inquire about the worries of the patient vis-à-vis his/her illness ITEM 15 Evaluate the support which the patient receives from those who are close to him/her
Q4	**Now let us consider another type of situation frequently encountered in practice. In the case where a young smoker consults for a particular problem unrelated to smoking, do you think the physician should do the following things?** ITEM 16 Obtain information on the smoking habits of the patient ITEM 17 Check if the patient knows the risks of smoking to his/her health ITEM 18 Encourage the patient to stop smoking
Q5	**Finally, in a case where a young obese person consults for a particular problem unrelated to obesity, do you think the physician should do the following things?** ITEM 19 Tell the patient what his/her ideal weight should be ITEM 20 Offer the patient your help if he/she decides to lose weight ITEM 21 Encourage him/her to lose weight

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Determinants of Condom Use among French Heterosexuals with Multiple Partners

Jean-Paul Moatti, PhD, Nathalie Bajos, Jean-Pierre Durbec, PhD, Collette Menard, and Caroline Serrand

ABSTRACT

In September 1988, a sample of French individuals between 18 and 49 years of age, who reported more than one sexual partner in the past six months and who considered themselves heterosexuals (n = 1088), were interviewed at home about risk perception of human immunodeficiency virus (HIV) transmission, sexual behavior, and condom use. Systematic or occasional use of condoms during the previous 12 months was reported by 46.9 percent of respondents. Among condom users, 38.7 percent declared they had never used condoms before the last 12 months, fear of acquired immunodeficiency syndrome (AIDS) rather than contraception being the main motivation of these recent users. Multivariate analysis indicates that voluntary testing for HIV, average or more than average fear of sexually transmitted diseases (STDs), and knowledge of HIV carrier in personal relations are associated with condom use. (*Am J Public Health* 1991; 81:106–109)

Introduction

Since the beginning of the AIDS (acquired immunodeficiency syndrome) pandemic, designing effective prevention has been hindered by a lack of basic information about sexual behavior. While changes in sexual behavior and condom use among homosexual and bisexual men are becoming documented,[1–4] data are still very scarce for the general population.[5] The most recent data on sexual behavior in a large sample of the French population were obtained in a 1969 governmental survey.[6]

France has the highest number of AIDS cases in Europe: 8,025 reported between 1978 and September 30, 1989. A total of 2,176 new cases were diagnosed between October 1, 1988 and September 30, 1989 with 11.5 percent of these cases being due to heterosexual transmission. Although, in France as in the United States, heterosexually acquired AIDS remains focused in demographically distinct population groups (sexual partners of bisexual males, intravenous drug users and individuals of African or Carribean origin),[7,8] prevention of heterosexual HIV (human immunodeficiency virus) spread remains a challenge.

The objective of the present study was to investigate condom use and its determinants in a national sample of French heterosexual population whose sexual behaviors are at risk for HIV transmission. The survey was carried out at a national level in September 1988 and supported by the French Committee for Health Education which was officially in charge of public information campaigns about AIDS.

Methods

The survey data are based on respondents between 18 and 49 years of age, who reported more than one sexual partner in the six months prior to interview and who considered themselves heterosexuals. Individuals were contacted at home. After a short presentation, a written list of various statements corresponding to possible combinations of multiple sexual partners (such as "I am currently married but I had an extramarital sexual relationship during the past six months," etc.) was submitted to the respondents, and they were asked if they recognized having been in at least one of these situations during the past six months. All those who answered positively were included in the survey and were interviewed face to face. The questionnaire included detailed data collection about sociodemographic characteristics and 62 questions about perception of the risk of HIV transmission, sexual behavior, and condom use. The interview lasted between 45 minutes and one hour. Sex of interviewer and respondent were not matched.

A quota sampling procedure for age, sex, occupational status, and size of town was used to select the sample. These quotas were a priori defined on the basis of the observed characteristics of the subgroup of heterosexuals reporting more than one sexual partner during the past six months in a previous survey on AIDS of French general population (December 1987).[9,10] Among the total number of individuals who were contacted at home, 15.3 percent (n = 1,008) and whose characteristics are listed in Table 1 were included in the sample. About half (49.8 percent) were single and a third (34.1 percent) were university graduates.

Univariate statistical analyses and multiple logistic regression analysis were performed with condom use as the dependent variable.

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TABLE 1—Frequency of Condom Use by Characteristics of the Respondents

Characteristics	% of Individuals Having Used Condoms during the Previous 12 Months
Sex	
Male (n = 501)	52.3
Female (n = 507)	41.6
Age (years)	
18–29 (n = 517)	50.7
30–39 (n = 325)	43.7
40–49 (n = 166)	41.6
Marital Status	
Single (n = 502)	52.6
Married or as married (n = 359)	41.2
Separated or widowed (n = 147)	41.5
Size of Town	
Less than 100,000 inhabitants (n = 432)	41.9
More than 100,000 inhabitants (n = 576)	50.7
Level of Education	
University graduates (n = 344)	51.7
College graduates (n = 222)	47.3
Lower level (n = 442)	43.0
Employment	
Executives, professionals and middle management (n = 351)	46.2
Employees and blue-collar workers (n = 423)	47.5
No occupation (n = 234)	47.0
Individual's Perception of Risk of Contracting AIDS	
Greater than average (n = 66)	53.0
Average (n = 235)	52.8
Less than average (n = 495)	46.3
None (n = 212)	40.1
Individual's fear of STDs	
Greater than average (n = 171)	55.0
Average (n = 475)	53.3
Less than average or none (n = 362)	34.8
Past Medical Care for STDs	
Yes (n = 215)	53.5
No (n = 793)	45.1
Testing for HIV	
Voluntary testing for HIV (n = 128)	71.9
HIV testing during systematic screening (n = 127) (blood donation)	44.4
No HIV testing but thought about having a test (n = 322)	47.8
No HIV testing and did not think previously about having one (n = 431)	39.7
Personal Knowledge of a HIV Carrier	
Yes (n = 153)	62.1
No (n = 855)	44.2

Results

Condom Use and Characteristics of Users

In this French sample, 46.9 percent reported having used condoms during the previous 12 months, 10.3 percent always using them. Among these 473 condom users, 38.7 percent declared they had never used condoms before the previous 12 months. These recent users mentioned fear of AIDS as their motivation for condom use in the same proportion as earlier condom users (65.0 percent vs 60.7 percent); however, they reported contraception as a motive for condom use less frequently (31.7 percent vs 62.8 percent).

Condom use is related to several sociodemographic characteristics of respondents as well as risk perception of contracting AIDS and STDs (sexually transmitted diseases) and past medical care for STDs (Table 1). It is of interest that 47.2 percent of respondents who feel being at "average" or "higher than average" risk of contracting AIDS do not yet use condoms (Table 1). Condom use is highest among respondents who voluntarily underwent testing for HIV antibodies and lowest in the non-tested population. It is also more frequent among respondents who personally know an HIV carrier (Table 1).

A minority of respondents (10.2 percent) believe that coïtus interruptus, vaginal douche, or to urinate after sexual intercourse may protect against HIV transmission; but their frequency of condom use is similar to that of the rest of the sample.

Determinants of Condom Use

When a logistic regression model is applied to condom use (either on some or all occasions of sexual intercourse in the last 12 months) and separate regressions are done by sex of respondents, the following variables appear to be related with use: voluntary testing for HIV, average or more than average fear of STDs and knowledge of HIV carrier in personal relations (Table 2).

Perception of Condom Use

Table 3 shows that expressed arguments about individual difficulties to use condoms such as "they are difficult to use" or "they reduce personal interest in sexual intercourse" do not differentiate users from non-users. It is rather criticisms of the social and cultural image of condoms with its potential effect on individual relationships that are more frequently expressed by non-users than users. Non-users also express more doubts about effectiveness of condoms to protect against transmission of HIV and other STDs.

Discussion

Several caveats must be recognized at the outset concerning our data. In the absence of sufficiently large and unbiased samples indicating the real prevalence of various sexual behaviors in the French population, our respondents cannot be considered as fully "representative" of French heterosexuals with multiple sexual partners. Inclusion in the study was based on individuals' willingness to recognize they had more than one sexual partner in the previous six months; so, reliability and validity of answers are difficult to assess (unfortunately, a possible influence of the interviewer's gender on the respondents' answers was not controlled). Our results are very similar to those observed in December 1987 in a representative sample of the population of 18 years of age and over of Paris region: in that survey of the general population, previous testing for HIV, being

TABLE 2—Factors Related to Condom Use in French Heterosexuals with Multiple Partners (logistic regression model)

	Male Respondents (n = 501)		Female Respondents (n = 507)	
Factors present	Odds Ratio	95% CI (*)	Odds Ratio	95% CI (*)
Voluntary testing for HIV	2.46	1.31, 4.59	3.27	1.82, 5.91
Average or more than average fear of STDs	1.44	1.19, 2.55	2.38	1.59, 3.56
Personal knowledge of HIV carrier	1.39	0.82, 2.35	1.95	1.13, 3.35
Age (**)	0.77	0.50, 1.17	1.07	0.70, 1.66
Unmarried	1.34	1.10, 1.85	1.39	0.92, 2.11
University education	1.17	1.00, 1.74	1.48	0.99, 2.20
Prior care for STDs	1.13	0.73, 1.77	0.99	0.61, 1.61

*The confidence interval is not symmetric because it has been calculated on the log odds.
**<30 vs ≥30 years of age.

TABLE 3—Expressed Opinions about Condoms

	Respondents		
% of Respondents Who Agree with the Following Statements about Condoms	Condom Users (%)	Condom Non-Users (%)	Difference (95% CI)
Are difficult to use	18.8	21.7	2.9 (−2.1, 7.9)
Reduce personal interest in sexual intercourse	60.7	64.2	3.5 (−2.5, 9.5)
Induce sexual impotence	5.5	6.2	0.7 (−2.2, 3.6)
Limit one's sexual pleasure	54.8	69.5	14.7 (8.8, 20.6)
Limit sexual pleasure of partners	59.6	62.4	2.8 (−3.2, 8.8)
Kill romanticism in relationship	62.6	76.8	14.2 (8.6, 19.8)
Create doubts about partner	28.1	40.0	11.9 (6.1, 17.7)
Are shameful to buy	7.2	12.3	5.1 (1.5, 8.7)
Should be considered like ordinary consumer goods	70.6	55.9	14.7 (8.8, 20.6)
Are not always effective STD protectors	55.2	66.4	11.2 (5.2, 17.2)

single, level of education, and declaring more than one sexual partner in the past six months were associated with condom use.[9,10]

Another limitation for our data is that those who report more than one sexual partner in the past six months may exhibit a wide variety of sexual behaviors to the risk of HIV transmission. Moreover, sexual-orientation self-reporting (i.e., heterosexual in our study) does not accurately describe an individual's sexual behavior: "heterosexuals," "bisexuals," and "homosexuals" may sexually interact across the boundaries implied by self-reported sexual-orientation.[11,12] Finally, condom use, especially if it is only occasional, is far from being a perfect indicator of protective behavior.

However, the aim of this study was to inform decision-makers in charge of public education campaigns about AIDS rather than to provide in-depth analysis of sexual behaviors. For that purpose, some useful indications and guidelines for general public information about condoms can be derived from our results.

Since 1987, French public health officials have tried to promote condom use through media advertising directed toward the general public (TV ads, newspapers, movies). It is well known that information alone does not cause sufficient change in behaviors, especially those which require significant changes in individuals' habits and self-representations.[13] It has even been argued that public education is particularly ineffective in areas or groups of low HIV prevalence.[14] Our study suggests a less pessimistic view: 18.2 percent of our sample being recent condom users of the last 12 months mainly motivated by fear of AIDS. It indicates that condom use has become relatively more acceptable in some segments of sexually active heterosexual population. Similar results have been found in The Netherlands where promotion of condom use in the general public also began in 1987.[15]

The experience of HIV prevention in the homosexual communities suggests that condom users are less likely than non-users to believe that condoms "spoil sex" and that interventions should focus on helping people develop strategies and techniques that make condom use sexually satisfying.[16,17] From our results, it seems that other aspects must also be taken into account:

- The importance of fear of STDs as a predictor for condom use suggests that it may be useful to include information about condoms in the general context of STDs rather than to only associate them with prevention of HIV infection. Evaluation of various types of messages will be necessary to further document this point.
- Although expressed doubts about effectiveness of condoms among non-users may be an posteriori rationalization of behavior rather than a real barrier to use, it seems necessary to point out the effectiveness of condoms as a means of prevention and to popularize technical quality controls of the product.
- The most important aspect of general information about condoms may be to change their social image and to promote them as ordinary consumer goods playing a normal role in sexual and affective relationships. That is what French information campaigns have called a strategy for making condoms "more of a social routine." Some evidence observed among IV drug users seems to reach similar conclusions.[18]

French campaigns now issue messages about condoms which do not explicitly associate them with AIDS prevention per se and which emphasize their use as non-conflicting with socially and individually valuable relationships. □

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Research on the Prevalence and Impact of Drug use in the Workplace: National Institute on Drug Abuse, Research Grants Program, Program Announcement No. PA-90-10, July 1990

The National Institute on Drug Abuse (NIDA) requests proposals from researchers in fields including but not limited to psychology, epidemiology, sociology, business and labor relations, public health, management, and economics, on the prevalence, etiology, and impact of acute, chronic, and "hangover" effects of drug use by the workforce. Specifically, NIDA requests proposals on:

- pacts of drug use on the workplace including absenteeism, accidents, injuries, job turnover, health care costs, and productivity effects;
- job performance assessment;
- simulation and field studies of workplace environments;
- prevalence and etiology of workplace-related drug use;
- prevalence estimation techniques for work-related populations; and
- studies of relationships among worker, job, and organizational characteristics, and patterns of drug use and consequences.

ADAMHA urges the inclusion of women and minorities in study populations. For further information contact: Workplace Performance and Technical Research Branch, Division of Applied Research, National Institute on Drug Abuse, Parklawn Building, Room 9A-53, 5600 Fishers Lane, Rockville, MD 20857, telephone (301) 443-6014.

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Cardiovascular Risk Factor Levels in Ethnic Hawaiians

ABSTRACT

We report a cardiovascular risk factor survey of "native" Hawaiians 20–59 years old (70 percent, or 257), living on the Hawaiian Homestead lands on the island of Molokai, Hawaii. More than 60 percent of both sexes were overweight. Among males, 42 percent were smokers. The percent of the population with systolic blood pressure greater than 140 mm Hg or a diastolic pressure greater than 90 mm Hg or taking hypertensive medications was 14 percent of those ages 20–39 and 36 percent of those ages 40–59. The percent with serum cholesterol ≥ 6.2 mmol/L ranged from 8 percent of those 20–29 years old to 46 percent in those 50–59 years old. Two percent of those ages 20–29 had a history of diabetes, or 2+ or greater glycosuria by dipstick, as did 23 percent of those ages 50–59. The majority of the known diabetics exhibited glycosuria and elevated glycohemoglobin levels, indicating poor control. Hypertension, although usually known to the participant, was frequently uncontrolled. From these data, it appears that among this group of Hawaiians major risk factors for cardiovascular disease were frequent, while at the same time the levels of awareness and/or control for most of these factors were low. (*Am J Public Health* 1991; 81:164–167)

J. David Curb, MD, N. Emmett Aluli, MD, Judith A. Kautz, Helen Petrovitch, MD, Synnove F. Knutsen, MD, Raymond Knutsen, MD, Helen K. O'Conner, and William E. O'Conner, MD

Introduction

In the first years of contact with Westerners, the native Hawaiian population was devastated by epidemics of infectious diseases. Today the life expectancy of native Hawaiians remains the lowest of all the major ethnic groups in Hawaii.[1] The death rate from cardiovascular disease of "pure" Hawaiians is more than twice Hawaii's overall rate.[2] There are, however, few scientifically gathered data on risk factors for cardiovascular disease in native Hawaiians. This study was aimed at providing initial insight into the patterns of cardiovascular risk in a native Hawaiian population.

Methods

A cardiovascular disease risk factor survey of native Hawaiians living on Hawaiian Homestead lands on the largely rural island of Molokai, Hawaii, was conducted in 1985 with strong support from a Hawaiian advisory group. Hawaiian Homestead lands consist of tracts of land allocated by federal law for long-term lease, in individual parcels, to native Hawaiians with at least 50 percent native Hawaiian ancestry. The residents of these areas live primarily in extended family homes. The survey was carried out in conjunction with the INTERSALT project, an international cooperative study on sodium intake and blood pressure.[3] Some data collection instruments and training were common to the two protocols.

There are today relatively few genetically "pure" Hawaiians. Those who identify themselves as Hawaiians have many different lifestyles. Of the major Hawaiian islands, the island of Molokai has the highest proportion of its population who are Hawaiians or part Hawaiians. Because Molokai has experienced fewer of the lifestyle changes associated with mass tourism than other islands, its Hawaiian population, especially that portion living in the Homestead areas, is thought to be more typically Hawaiian. There is widespread unemployment and access to health care is limited.

A list of the individuals, by age and sex, known to be living in the Homestead areas was developed by interviewing longtime residents of the areas, examining hospital and clinic records and voter registration lists, and visiting most homes in the area. Introductory letters, brochures, and newspaper publicity as well as extensive telephone contact and visits to homes by staff and Hawaiian volunteers were used to recruit study participants. The population of individuals 20–59 years of age, excluding pregnant women, was defined as the target population. At the clinic appointment, health, lifestyle (smoking, alcohol use, and physical activity), and de-

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TABLE 1—Number of Individuals Examined, by Age and Sex

Sex	20–59 Years	20–29 Years	30–39 Years	40–49 Years	50–59 Years
Male	123	29	30	37	27
Female	134	27	46	35	26
Total	257	56	76	72	53

mographic questionnaires were administered. Nonfasting blood was drawn for cholesterol, triglyceride, high-density lipoprotein (HDL) cholesterol, and glycosylated hemoglobin measurements. Height, weight, and blood pressure were measured. Spot urine specimens were tested for protein and for glucose by means of dipsticks.

Blood specimens were refrigerated immediately and processed within four hours of collection. Serum specimens were frozen and transported frozen to the laboratory for analysis. Whole blood specimens were transported on ice for glycohemoglobin determinations, which were carried out within three to four days after collection.[4] Standardized Lipid Research Clinic procedures were utilized to determine serum lipid values.[5] Three sitting blood pressures were taken, after five minutes of rest, by individuals certified with the London School of Hygiene audiotape.[3] For each subject's blood pressure value in analyses, an average of the last two blood pressures was used. Hypertension was defined as either taking antihypertensive medications or having a diastolic blood pressure of 90 mm Hg or greater, or a systolic pressure of greater than 160 mm Hg.

Where appropriate, 95 percent confidence intervals (CIs) were calculated for total male and female rates based on the normal approximation to the binomial distribution.[6] These tended to be relatively wide because of the small sample size, and small numbers made the procedure inappropriate for the age-sex cells. Computer analyses of the 1976–80 National Health and Nutrition Examination Survey (NHANES II)[7] and the 1985 National Health Interview Survey (NHIS)[8] were conducted to provide comparative data on a national scale for comparable age groups.

Results

Tables 1 and 2 contain subject frequencies by age and sex and mean values and rates by sex for selected cardiovascular disease risk factors. Among the 367 persons identified as eligible, 257 (70 percent) participated in the study: 61 percent of the 20–29 age group, 72 percent of the 30–49, and 80 percent of the 50–59.

Approximately 65 percent of the participants were 20 percent or more above the average body mass index (weight-height ratio^2) for Caucasians, compared with 27 percent of all US adults ages 20–59.[9] Forty-five percent of the Hawaiians were 40 percent or more overweight by these standards.[9] The mean waist-hip ratio was higher than a 0.80 cut point,[10] indicating upper-body fat predominance, in all sex and age groups among the Hawaiians, but the finding was more marked in males.

Approximately 34 percent (95% CI = 26, 42) of females and 42 percent (95% CI = 32, 51) of males admitted to being current smokers by questionnaire. The highest prevalence of smoking was seen in males ages 20–29 (48 percent). Overall an additional 26 percent of males and 15 percent of females were past smokers.

The prevalence of high blood pressure or taking antihypertensive medications was 24 percent (95 percent CI = 19, 31) in females and 26 percent (95 percent CI = 19, 33) in males. The proportions are similar to those of Whites (Figure 1). Fewer than 7 percent of those meeting the criteria used for blood pressure elevations in these analyses had not been told previously that they had high blood pressure. However, among the 10 percent of the total population taking antihypertensive medications, 81 percent of females and 90 percent of males still had high blood pressures as defined.

The prevalence of individuals in the population with serum cholesterol of 5.2 mmol/L or higher was 50 percent for the males (95% CI = 41, 59) and 45 percent for the females (95% CI = 37, 53). The prevalence of those with serum cholesterol of 6.2 mmol/L or greater ranged from 9 percent in those ages 20 to 29, to 40 percent of those ages 50 to 59. The age-adjusted mean HDL was considerably lower

TABLE 2—Mean Values and Standard Deviations for Selected Cardiovascular Risk Factors in 257 Ethnic Hawaiians, by Age and Sex

Risk Factors and Sex	20–59 Years Mean	20–59 Years (SD)	20–29 Years Mean	20–29 Years (SD)	30–39 Years Mean	30–39 Years (SD)	40–49 Years Mean	40–49 Years (SD)	50–59 Years Mean	50–59 Years (SD)
Serum cholesterol (mmol/L)										
Male	5.28	(1.24)	4.68	(1.24)	5.25	(1.34)	5.66	(0.96)	5.51	(0.44)
Female	5.25	(1.32)	4.63	(1.01)	5.02	(1.19)	5.30	(1.42)	6.26	(1.22)
Serum HDL-cholesterol (mmol/L)										
Male	1.01	(0.26)	1.06	(0.28)	0.98	(0.25)	0.96	(0.23)	1.03	(0.27)
Female	1.09	(0.24)	1.09	(0.24)	1.06	(0.23)	1.06	(0.24)	1.16	(0.27)
Body mass index[a]										
Male	32	(7.4)	31	(6.0)	32	(4.3)	33	(8.9)	31	(6.7)
Female	31	(8.1)	29	(7.1)	31	(7.9)	32	(8.7)	32	(8.6)
Waist/Hip Ratio										
Male	.95	(0.77)	.91	(0.07)	.93	(0.05)	.98	(0.08)	.97	(0.06)
Female	.84	(0.77)	.81	(0.05)	.83	(0.07)	.86	(0.07)	.86	(0.08)

[a]weight/height ^{2}

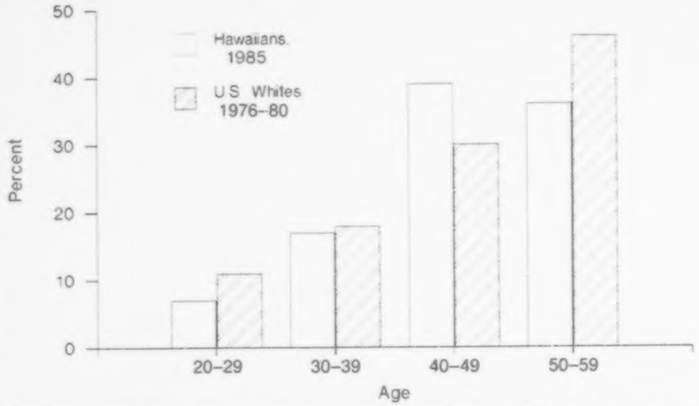

FIGURE 1—High Blood Pressure in Hawaiians vs. US Whites. Criteria of high blood pressure were diastolic blood pressure ≥ 90, or systolic blood pressure ≥ 140, or being on a regimen of antihypertensive medications. Data on US Whites are from the National Health and Nutrition Examination Survey, 1985.

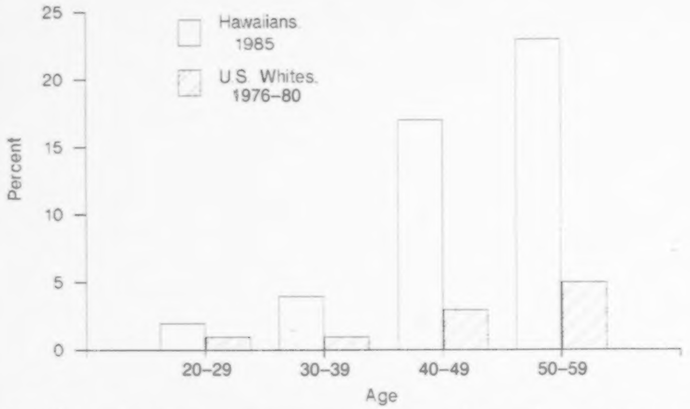

FIGURE 2—Diabetes in Hawaiians vs. US Whites. The percent of Hawaiians who said their doctors had told them they had diabetes or who showed significant glucose spillage (≥2+) in their urine at exam is compared with US Whites' rates of self-reported diabetes from the National Health and Nutrition Examination Survey, 1985.

among Hawaiian males (1.01 mmol/L [95% CI = 0.61, 1.55]) and especially in females (1.08 mmol/L [95% CI = 0.58, 1.58]) than values found for Whites of similar ages in the Lipid Research Clinics studies (males 1.16 mmol/L and females 1.49 mmol/L), indicating the possibility of substantially higher cardiovascular risk for Hawaiians.[11,12]

As shown in Figure 2, there was significant glycosuria (≥2+) in the spot urine or a history of the individuals being told they had an elevated blood sugar in 10 percent of females (95% CI = 5, 15) and 12 percent of males (95% CI = 6, 18). Among those 20–29, 30–39, 40–49, and 50–59 years of age, glycosylated hemoglobin levels greater than .11 were found in 2 percent, 7 percent, 8 percent, and 17 percent of these age groups, respectively, indicating an increased probability of glucose intolerance or poor control of diabetes.

Although there was no standardized follow-up, most of the six previously undiagnosed individuals with glycosuria are known to have been subsequently diagnosed by local physicians as having diabetes. The majority of the known diabetics were under poor control as evidenced by spillage of glucose in the urine and/or very high glycosylated hemoglobin levels.

Discussion

NHANES II found that 27 percent of US adults ages 20–59 were overweight,[9] compared with 65 percent of native Hawaiians in this survey, which used the same cut points for body mass index. The native Hawaiian males had more than twice the prevalence of overweight of US males in all age groups, whereas native Hawaiian females had 50 percent higher prevalence than US females. The predominantly upper-body type of fat distribution found in Hawaiians has been reported to be independently associated with higher risk of subsequent cardiovascular disease than is lower-body fat predominance.[10] However, ethnic differences in physiology and in the concept of ideal weight may contribute to the differences seen. Data from the 1985 NHIS indicate that 35 percent of US males and 31 percent of females in the age range 20 to 59 smoke.[7] The smoking rates among native Hawaiians appeared to be somewhat higher, and the age-specific patterns were most similar to US Blacks.

High rates of glucose intolerance have been found in some American Indian tribes.[13] Among urban Polynesians other than Hawaiians, rates of more than 12 percent for males and 11 percent for females have been reported, whereas rural rates are lower (1 to 4 percent).[14,15] In other Pacific populations, Micronesians from affluent, relatively westernized Nauru have a 30 percent prevalence of diabetes,[16] and Melanesian rates are low with rates in Fiji of 1.1 percent in the rural environment and 3.5 percent in an urban environment.[17] Many studies have implicated urbanization or westernization as a major risk factor for diabetes.[18]

The population studied was small, and previous experiences have made the Hawaiians suspicious of medical researchers; consequently overall response rates were held to 70 percent. For reasons of this kind, there are few population-based data on Hawaiians. In this study we had no indication that we were more or less successful in recruiting individuals with disease or elevated risk factors than healthier individuals, although the older individuals—who are more likely to have diagnosed disease and known risk factor elevations—were more likely to participate. As in any socioeconomically depressed population, out-migration is a problem and recruitment was somewhat more difficult in the young because of such factors as peer pressure, disillusionment, and work restrictions. As in any study, selective nonparticipation of healthy or ill individuals may have been possible. In order to better characterize the native Hawaiian population it is imperative that larger, better funded studies be carried out by working closely with native Hawaiians in multiple communities.

From these data, it appears that Hawaiians may be at high risk of premature coronary heart disease and stroke due to obesity, hypertension, hypercholesterolemia, low levels of HDL, smoking, and diabetes mellitus. In this population, individuals who were found to have significant abnormalities in the cardiovascular disease risk factors studied were often unaware of them, not under treatment, or not under adequate control. Such findings probably indicate serious deficiencies in health care systems and the knowledge of the population about the associated disease processes. ☐

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HIV Risk Behavior Reduction following Intervention with Key Opinion Leaders of Population: An Experimental Analysis

ABSTRACT

Background and Purpose. Peer norms influence the adoption of behavior changes to reduce risk for HIV (human immunodeficiency virus) infection. By experimentally intervening at a community level to modify risk behavior norms, it may be possible to promote generalized reductions in HIV risk practices within a population.

Methods. We trained persons reliably identified as popular opinion leaders among gay men in a small city to serve as behavior change endorsers to their peers. The opinion leaders acquired social skills for making these endorsements and complied in talking frequently with friends and acquaintances. Before and after intervention, we conducted surveys of men patronizing gay clubs in the intervention city and in two matched comparison cities.

Results. In the intervention city, the proportion of men who engaged in any unprotected anal intercourse in a two-month period decreased from 36.9 percent to 27.5 percent (−25 percent from baseline), with a reduction from 27.1 percent to 19.0 percent (−30 percent from baseline) for unprotected receptive anal intercourse. Relative to baseline levels, there was a 16 percent increase in condom use during anal intercourse and an 18 percent decrease in the proportion of men with more than one sexual partner. Little or no change was observed among men in the comparison cities over the same period of time.

Conclusions. Interventions that employ peer leaders to endorse change may produce or accelerate population behavior changes to lessen risk for HIV infection. (*Am J Public Health* 1991;81:168–171)

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Introduction

Experience in many health promotion areas supports the importance of social influence as a determinant of population risk behavior patterns.[1-3] Gay men who successfully implement risk reduction report greater peer support for behavior change than their unsuccessful counterparts,[4-6] while beliefs that one's friends have already made precautionary changes and that these changes will be well accepted predict compliance with acquired immunodeficiency syndrome (AIDS) risk reduction recommendations.[5,6] Reductions in high-risk sexual behavior among homosexual men in urban centers appear linked to new norms in the gay communities of large cities which discourage high-risk activities such as unprotected anal intercourse and encourage precautionary steps such as condom use or other safer sex modifications.[7,8]

Persons frequently seek the advice of friends concerning steps needed to reduce risk for AIDS.[9] Diffusion of innovation theory posits that trends and innovations are often initiated by a relatively small segment of opinion leaders in the population.[10] Once visibly modeled and accepted by natural opinion leaders, innovations then diffuse throughout a population, influencing others. The purpose of this investigation was to experimentally test an AIDS prevention intervention based on diffusion of innovation/social influence principles. Because HIV (human immunodeficiency virus) risk behavior levels remain high among gay men in small cities[5,6,11] and because geographically isolated communities constitute compact environments where it is feasible to experimentally evaluate community-level intervention of this kind, the project targeted homosexual men in small cities.

Methods

Setting and Baseline Survey

The study was conducted late in 1989 in Biloxi and Hattiesburg, Mississippi, and Monroe, Louisiana, selected because they are relatively small (populations of 50,000 to 75,000 residents), separated by at least 60 miles from one another or from any other city of larger size, and because each city had one or two large gay bars. Due to the geographical isolation of the cities and the paucity of other meeting places, these clubs tend to attract large, stable crowds of homosexual men and serve as the primary social setting in each city's gay community. An earlier survey of men patronizing clubs in these cities revealed alarmingly high rates of high-risk sexual behavior.[6] AIDS incidence data for the cities are not compiled, but data from local health department HIV testing sites indicate relatively low seroprevalence rates (approximately 2 percent) among all men who seek testing in the cities. This suggests that HIV infection prevalence is still moderate but will increase unless behavior changes among gay men are quickly implemented.

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To obtain baseline data on population AIDS risk characteristics, men entering each city's clubs were initially surveyed over three consecutive nights. The survey measure was completed anonymously and individually at small tables located near the club entrances; men who completed the questionnaire on one night did not complete it again during the same three-night sampling period. In addition to demographic information, the measure assessed:

- knowledge about AIDS risk behaviors and risk reduction steps using a 23-item true/false test[12];
- perceived social norms concerning the acceptability of adopting safer sex precautions measured by endorsement on 5-point Likert scales of five statements (example: "My gay male friends insist on using condoms when they have intercourse") and yielding scores of 5 to 25[5,6]; and
- personal sexual behavior occurring over the past two months, including number of occurrences and different partners for unprotected insertive and receptive anal intercourse, anal intercourse with condoms, and other low-risk practices (frottage, mutual masturbation, and similar activities). This measure was pilot tested extensively and has been successfully used in prior surveys of gay men's risk behavior.[5,6,11]

The same survey procedure was repeated in a second three-day sampling period four months later at each club in each city to establish baseline stability in population risk characteristics. A preliminary review of survey data revealed that AIDS risk knowledge scores were consistently high among men in each city ($M = 21$ of 23 items answered correctly) so basic knowledge items were deleted from subsequent surveys. Counts were made of the total number of men who entered clubs to determine the proportion of the entire population successfully surveyed.

Study Design and Intervention Procedures

Following baseline population assessments in all cities, one community (Biloxi) was randomly selected to receive the intervention while the other two communities served as comparison cities. The comparison cities received no specific intervention, although AIDS prevention posters and brochures were generally available in gay clubs in the cities. No significant differences in population risk behavior were found between the two comparison cities.

In the intervention city, a three-stage process identified, trained, and then contracted with popular opinion leaders among gay men to endorse behavior change to their peers.

Identification of Opinion Leaders: To identify key popular people, four club bartenders familiar with population members were trained to observe social interaction patterns within the city's gay clubs. Each made unobtrusive behavioral observations in the clubs for one week, recording first names and a physical identifier for 30 persons observed to socialize and be greeted positively most often by men in the clubs. Recording sheets were cross-matched for repeated mention; 36 of a total of 82 names received multiple nominations and were considered key popular people. Twenty-two were located, entered in the program, and asked to invite one friend also considered to be highly popular with gay men and not already a participant. The total training group consisted of 39 men and four women with a mean age of 30 years and a mean education level of 13.8 years; 91 percent of the group was White and 9 percent African-American or Hispanic.

Training the Opinion Leaders: The training consisted of four weekly, 90-minute group sessions led by a male and a female leader. In session one, the leaders reviewed basic epidemiology of HIV infection, high-risk behavior, and precautionary changes needed to reduce risk and misconceptions concerning risk. They discussed the steps that can be used to successfully implement risk reduction, including: keeping condoms readily available if sexually active; avoiding excessive intoxicant use before sex; discussing precautions in advance with sexual partners; resisting coercions to engage in high-risk practices; and self-reinforcing for behavior change efforts.

Session two described characteristics of effective health promotion messages: sensitizing others to the potential threat of AIDS; stressing that HIV infection can be prevented by behavior change; identifying specific behavior changes needed to reduce risk; suggesting strategies for implementing these changes; using self as an example in order to avoid a "preachy" tone (i.e. beginning statements with "I am learning to . . ." rather than "You should . . ."); and personally endorsing the positive value and desirable benefits of behavior change.

In the third session, leaders modeled conversational examples which incorporated the characteristics discussed in session two. Following discussion of the enactments, participants role-played how they would initiate conversations, incorporating these message characteristics. Group leaders and assistants observed this social skill rehearsal, providing feedback and suggestions. After becoming proficient in the role-plays, each participant identified four gay male friends with whom s/he could initiate an endorsement conversation in the next week. Monitoring forms were provided for recording descriptions of these conversations.

Session four reviewed outcomes of the real-life conversations; most participants reported positive reactions from others. The leaders and participants then problem-solved persons, settings, strategies, and times which would afford opportunities to initiate additional conversational contacts with other peers. All members agreed to initiate and monitor at least 10 more peer conversations over the next two weeks. The session concluded with further discussion emphasizing the participants' important role in stressing the benefits of behavior changes to prevent HIV infection among gay men in their own community. Of the 43 opinion leaders who began the intervention, 35 attended all the sessions.

Later review of participants' self-monitoring forms indicated that 371 peer conversations were monitored over the two-week period. This probably underestimates the number of conversations which actually took place because peer conversations were likely to have continued beyond the monitoring phase. In addition, before and after the training program, each opinion leader was asked to role-play standard, simulated peer educational conversations. Ratings of the tape recorded role-plays were made by trained judges, naive to whether practice conversations were pre- or postintervention. These rates revealed that, after training, the opinion leaders more frequently exhibited skills taught in the program (data available on request to author). These checks confirm social skill acquisition and conversational assignment compliance by the opinion leaders.

To stimulate opportunities for initiating peer conversations, posters with a traffic light logo (red, yellow, and green circles) but no printed explanation were placed throughout the clubs shortly before the end of the intervention. Each training participant was given a small lapel button with the same logo and asked to wear it. Participants reported that this cuing device led many people to inquire about the

TABLE 1—Measures of Behavior in Surveyed Populations Prior to Intervention and Behavior Change Postintervention

	Preintervention		3–6 Month Changes		
Behavior Characteristics[a]	Intervention City	Comparison Cities	Intervention City	Comparison Cities	Difference (95% CI)
Percent of Respondents Engaging in:					
Any Unprotected Anal Intercourse	36.9	40.4	−9.4	−2.9	6.5 (6.4, 6.6)
Unprotected Receptive Anal	27.1	30.9	−8.1	−3.7	4.4 (4.3, 4.5)
Unprotected Insertive Anal	31.5	31.5	−9.6	+0.4	10.0 (9.9, 10.1)
Percent of Anal Intercourse Occasions Protected by Condoms:					
Any Anal Intercourse	48.8	54.5	+6.5	−6.1	12.6 (12.5, 12.7)
Receptive Anal Intercourse	50.4	55.4	+8.0	−7.8	15.8 (15.7, 15.9)
Insertive Anal Intercourse	49.2	54.7	+5.2	−5.1	10.3 (10.2, 10.4)
Percent of Respondents Reporting Multiple Sexual Partners	42.4	38.2	−7.8	+1.9	9.7 (9.6, 9.8)

[a] In two months prior to survey point.

TABLE 2—Percentage Distribution for Number of Sexual Partners for Unprotected Anal Intercourse in Prior Two Months: Intervention and Comparison Populations Before and After Intervention

	Intervention City		Comparison Cities	
Number of Partners	Pre	Post	Pre	Post
0	70.7	80.0	68.8	70.9
1	7.1	5.2	7.9	8.4
2	4.2	3.4	3.5	3.7
3	2.0	1.0	4.0	3.4
4	1.9	1.3	6.5	6.6
5	2.6	0.9	2.5	4.0
6	2.9	1.2	1.3	0.8
7+	8.6	7.1	5.5	2.2

meaning of the symbol. These questions, in turn, stimulated opportunities to explain precautionary changes from the traffic light scheme (high-risk, moderate-risk, low-risk) and endorse these changes in the conversational style that was practiced in training. The lapel buttons also served as visual cues which reinforced the endorsement of behavior change by well-known and popular individuals.

Several months after the intervention's completion, participants were recontacted by telephone, encouraged to continue their peer education conversations, and commended for their continued efforts.

Determining Change in Population Risk Characteristics

Surveys of all male club patrons in all cities were repeated in the same manner as at baseline three months and again six months after the end of the training period. Responses of training participants were excluded. Intervention city men reported they were approached to initiate a mean of 7.1 conversations, demonstrating that the conversations encouraged in the training program occurred frequently.

Results

A total of 659 surveys were completed at the two baseline survey periods (intervention city N = 328, comparison cities N = 331) and 608 men completed surveys at the two postintervention periods (intervention city N = 278, comparison cities N = 330). This was an average of 81 percent (range = 68 to 88 percent) of all men patronizing each city's clubs during the survey periods. Between 24 and 47 percent of the men who completed measures on one occasion were the same men who completed them earlier; over 70 percent of respondents lived in the city where the survey was conducted. The mean age of all men surveyed was 29.1 years; the mean education level 14.9 years; 86 percent of men were White and 14 percent African-American or Hispanic. There were no significant differences between intervention and comparison city populations, nor were there systematic changes over time within a city's surveyed population, for these characteristics.

Table 1 presents behavioral characteristics for both the intervention and comparison cities before and following intervention with 95% CIs of the differences in behavior change. For purposes of brevity, results of the two baseline surveys and the three- and six-month postintervention surveys are averaged as a single figure. Populations in the intervention and comparison cities were initially comparable in risk characteristics. At the postintervention surveys, the proportion of men who engaged in unprotected anal intercourse decreased by about 30 percent from their initial levels. Much less change was evident in the population of men in the comparison cities. Similarly, there was an increase in proportion of all anal intercourse occasions when condoms were used only in the intervention city. Finally, the intervention produced a decrease in the proportion of intervention city men who reported having multiple sexual partners in the preceding two months, an effect not found in the comparison cities.

Table 2 shows the percentage distribution for number of sexual partners in the intervention and comparison populations before and after intervention. These results show some shifts reflecting an increased proportion of intervention city men who had either one or no sexual partner from pre- to postintervention and slight general decreases in the proportion of men who had two or more partners (Z

= 1.66, $p < .05$ for nonparametric Wilcoxon signed rank test).

Survey responses of the male opinion leaders, examined separately, showed that in the two months before training, 39 percent of opinion leaders engaged in unprotected anal intercourse; in the postintervention survey, 24 percent engaged in this practice.

Distinctive changes in social norm measure scores were not associated with the intervention; only a general and modest pre- to posttest increase in scores was found (from $M = 15.6$ to 17.0). However, intervention city men who refrained from unprotected anal intercourse reported in posttest surveys receiving health message conversations from peers more ($M = 6.3$ conversations) than men who still engaged in unprotected receptive anal intercourse ($M = 3.5$) or in any unprotected anal intercourse ($M = 4.8$).

Discussion

To the best of our knowledge, this constitutes the first report of an experimentally controlled study evaluating a community-level field test of an intervention for HIV risk reduction. This study found that engaging key opinion leaders popular with gay men in small cities to serve as behavior change endorsers to their peers, produced reductions in the proportion of men in the population who engaged in high-risk activities and produced concomitant, population-wide increases in precaution-taking. The magnitude of these shifts compares favorably to those commonly found following mass, community-based population intervention for other health behavior problems such as cigarette smoking and cardiovascular risk reduction. This suggests a cost-effective HIV prevention model which may be of benefit in interventions with gay men, intravenous drug users, adolescents, and other groups.

Several findings in this study were of particular interest. First, AIDS risk behavior knowledge scores were high among men in each city even before intervention, suggesting that lack of knowledge about AIDS was not a critical dimension in the populations studied and that intervention methods which induce behavior change implementation and social acceptability of changes are needed. Second, while we anticipated that the intervention would alter perceptions of social norms, the norm measure did not reflect changes parallel to the population behavior shifts. Generalized changes in sexual behavior may precede peer norm changes rather than cause the initial adoption of risk reduction. In that case, elements of the intervention responsible for population behavior change may have included frequent safety prompts delivered by credible peers, conversational dissemination of suggestions for implementing precautionary changes, legitimization of making risk reduction changes by opinion leaders, or other factors.

While the study's results are highly promising, a number of cautions must be raised. We studied only men who patronized clubs and relied on self-reports of behavior. However, the geographical isolation of the study cities, the stability of club populations over time, and the function of clubs as the major social setting for gay men in these communities supports the relevance of data collection at these sites. While self-report behavior measures are essential in large-scale HIV risk behavior research, other data corroborating population behavior change—such as changes in community STD (sexually transmitted disease) incidence, condom purchasing patterns, or HIV testing requests and infection incidence—are needed to substantiate future conclusions about intervention impact. Finally, only a small number of cities were involved in this demonstration. Wider-scale clinical field trials of such experimental models in multiple cities and with larger populations are needed to establish their generalizability. ☐

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Motorcycle Licensure, Ownership, and Injury Crash Involvement

ABSTRACT

The interrelationships among motorcycle licensure, ownership, and injury crash involvement were investigated in a sample of 2,723 motorcycle drivers severely or fatally injured in California in 1985–86. Owners of motorcycles in such crashes ("driver-owners") were less likely to have valid licenses than a random sample of motorcycle owners who had not been in crashes (42 vs. 57 percent). Thirty-three percent of the crash-involved drivers had valid motorcycle driver's licenses; 39 percent were operating motorcycles they did not own ("driver-nonowners"). Driver-nonowners were less likely to be validly licensed than driver-owners (20 percent vs. 44 percent). The licensing rate of crash-involved driver-nonowners was 15 percent if the owner was also unlicensed. Rates of valid licensure were lowest among the youngest drivers. Virtually no crash-involved driver-nonowners under age 21 were licensed in cases in which the owner was also young and unlicensed. (*Am J Public Health* 1991;81:172–176)

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Introduction

In most states a special license is required to operate a motorcycle on public streets and highways. There is evidence, however, that many of the motorcycle drivers killed or seriously injured in crashes did not have a license to operate a motorcycle. Hurt and associates* reported in an unpublished document that 46 percent of 900 motorcycle drivers involved in crashes in Los Angeles in 1976–77 were not validly licensed. Data from the US Department of Transportation's Fatal Accident Reporting System (FARS)** show that about 43 percent of motorcyclists killed on public roads or highways in the United States did not hold a valid motorcycle operator's license. In both reports, however, there was no information given on licensure status of motorcyclists not involved in injury crashes. Neither of these data sets provides information on whether the injured were driving motorcycles they owned, nor do they indicate whether lack of licensure was associated with increased crash risk. Barry[1] noted 20 years ago that a substantial percentage of operators of motorcycles involved in injury crashes had "borrowed" the vehicle, but the report did not include information on whether the motorcyclists were licensed.

The present study was designed to address the following questions:

- Do motorcycles owned by people without motorcycle licenses have greater likelihood of crash involvement?
- To what extent do motorcycle drivers in serious and fatal injury crashes have valid licenses? own the motorcycle they were driving?
- How does motorcycle licensure vary by whether the crash-involved driver owned the motorcycle ("driver-owner" vs. "driver-nonowner")?
- How is motorcycle licensure affected by the relationship between crash-involved driver-nonowners and owners, when other relevant factors are also controlled?

Methods

A valid motorcycle license in California is a "class 4" license or, more frequently, a motorcycle endorsement to another class of license. Motorcycle licensure requires a written examination and driving test for two-wheeled vehicles. Motorcyclist training was not required for any drivers prior to 1988.[2]

Crash-Involved Motorcycles

Motorcycle crashes that occurred between July 1, 1985 and October 31, 1986

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*Hurt *et al*: Motorcycle accident cause factors and identification of countermeasures. Traffic Safety Center, University of Southern California, Los Angeles, 1981.

**Buchanan L: Presentation at Transportation Research Board Meeting, Washington, DC, 1988.

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TABLE 1—Availability of Information on License Status and Percent Validly Licensed Motorcyclists among Owners and Drivers of Motorcycles in Study Group

Driver/Ownership Status	Total Number	Driver License Information Number (%) with Known License Status	% with Valid License for Operating a Motorcycle among Those with Known License Status
MOTORCYCLES IN CRASHES			
(a) Driver-owner	1,467	1,438 (98)	44
(b) Driver-nonowner	930	875 (94)	20
(c) Owner-nondriver	930	525 (56)	35
(d) Driver-unknown if owner	326	241 (74)	10
All drivers (a,b,d)	2,723	2,554 (94)	33
All owners (a,c)*	2,397	1,963 (82)	42
MOTORCYCLES NOT IN CRASHES			
Owners	13,638	8,648** (63)	57

*Excludes 326 cases in which ownership was undetermined.

**Subsequent results based on 6,965 motorcycle owners with license records (see Methods section).

on a California road, street, or highway were identified using the California Highway Patrol (CHP) Statewide Integrated Traffic Records Systems (SWITRS) and the original police reports. Crashes analyzed were limited to those in which the motorcycle driver was fatally or severely injured. A severe injury was defined by the CHP[3] as a cut or laceration of skin from which blood flows freely or saturates clothing, and also includes an extremity not in normal position, indicating fracture. In almost all cases, the injured driver was taken to a hospital by an ambulance or paramedic unit.*** Mopeds, scooters, all-terrain vehicles, other off-road vehicles, motorcycles of 1980 or earlier model years, and motorcycles with out-of-state registrations were excluded.

The SWITRS and the police reports provided data about the driver (driver's license number, age, sex, and extent of injury); the vehicle (vehicle license number, identification number—when recorded—make, and model year), and name and address of the registered owner.

Crash-Involved Drivers: The license status of injured drivers was determined from the California Department of Motor Vehicles (DMV) driver history file using the driver's license number recorded on the crash report. Drivers not licensed to operate motorcycles were classified as having a valid license for another class of vehicle, having a suspended or revoked license, or having no license at all.

Unlicensed operators included the following categories: no driver's license number recorded on the crash report, those whose license expired before the crash date, those whose license was first issued after the crash date, driver's license number beginning with "X" (indicating a DMV file with information on violations and crashes but no driver's license issued), and those with the DMV identification card only.

License status was classified as unknown if the driver was licensed in another state or country, if the driver was listed on the crash report as having an instruction permit or a temporary license, or if no computer record could be located for the driver's license number written on the crash report. If the driver's license history contained no record of a crash on the date of interest and the driver's birth date was inconsistent with the age on the crash report, the driver's license history data were not used and license status was also considered to be unknown.

Owners of Crash-Involved Motorcycles: In cases in which the crash-involved driver did not own the motorcycle, information on the license status of the owner was obtained. Because the owner's name and addresses—but not the owner's driver's license number—are on the crash report, it was necessary to match the name and address information on the crash report with name and address information on the California driver's license history file to identify the owners' driver's license number and obtain licensure information.

Owners of Motorcycles Not in Crashes (Comparison Group)

A comparison group composed of a random sample of 13,638 motorcycles, representing 4.5 percent of all registered motorcycles in California, was selected from the DMV vehicle registration file as of November 1, 1986. Inclusion in this sample was restricted in the same way as for motorcycles involved in crashes.

The chance of a motorcycle being included in the sample was proportional to the number of months in which it was validly registered in California during the study period. Once in the sample, motorcycles were assigned with equal probability to each of the 16 months in the study during which they were registered for use. This procedure resulted in a comparison sample that included every motorcycle that was registered during a month with equal probability for that month.

The driver's license history for the owners of motorcycles in the comparison sample was obtained in the following way. The status of the license was determined for the reference month to which the motorcycle was assigned for comparison. Of the initial sample of 13,638 motorcycles, name and address for the registered owner were available for 12,481 of them (92 percent). The driver's license number was located for 8,669 of the 12,481 (69 percent). Of the 8,669, a driver's license history file was located for 8,648 owners (99.8 percent). Based on the vehicle identification number, 8,510 of the vehicles were found to be true motorcycles. Driver's license histories of owners were randomly discarded until all months had a sampling ratio of 2.56 controls per case, the ratio found in the sparsest month. The final comparison sample included 6,965 vehicle owners.

Results

Licensure Information

The information available for subgroups of motorcycle owners and drivers is provided in Table 1. Licensure information was available for 94 percent of crash-involved drivers but for only 56 percent of owners of motorcycles in crashes who were not driving the motorcycle and for 63 percent of the comparison sample of owners of motorcycles not in crashes.

Licensure Rates

Table 1 also provides a summary of motorcycle licensure rates for the various groups of motorcycle owners and drivers.

***Personal communication, California Highway Patrol, April 1990.

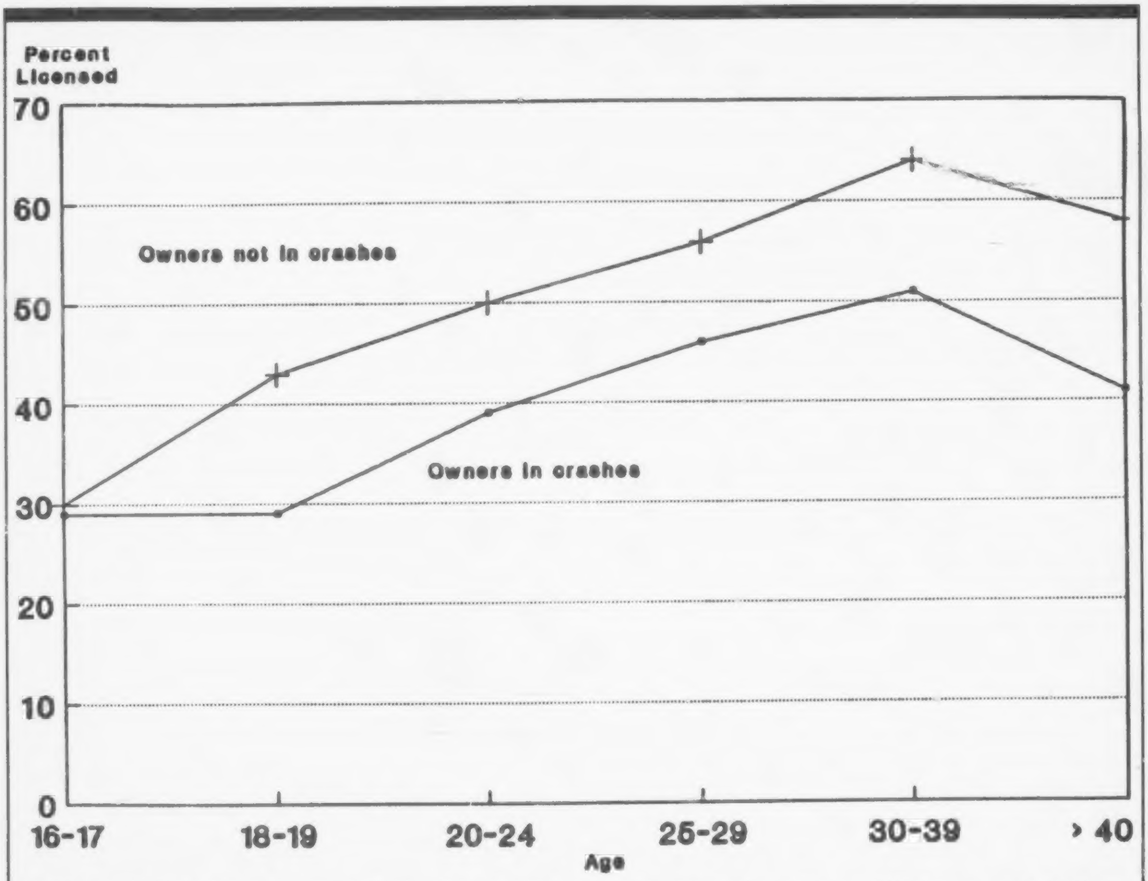

FIGURE 1—Percent of Validly Licensed Motorcyclists: Owners of Motorcycles in Crashes vs. Owners of Motorcycles not in Crashes, by Age

Owners: Owners of motorcycles in crashes were less likely to have valid licenses than motorcycle owners not in crashes (42 percent vs. 57 percent, odds ratio [OR] = 0.53, 95 percent confidence interval [CI] = 0.48, 0.59). Owners of crashed motorcycles were younger than the comparison group of motorcycle owners: 44 percent were under age 25 compared with 22 percent of the comparison group (OR = 2.86, CI = 2.58, 3.18). Owner licensure rates in both groups increased with age until age 40; fewer owners age 40 and over were licensed than owners ages 30–39. Figure 1 shows that the younger age of owners of crashed motorcycles did not account for the relationship between owner licensure and crash involvement. At all ages, owners of crashed motorcycles were less likely to be validly licensed than owners not in crashes (OR = 0.60, CI = 0.54, 0.66).

Owners of motorcycles in crashes who were operating the motorcycle were also less likely to be validly licensed than motorcycle owners not in crashes (44 vs. 57 percent, OR = 0.59, CI = 0.53, 0.66).

Drivers: Overall, 33 percent of crash-involved drivers were validly licensed. Valid licensure was strongly associated with age. The lowest licensure rate was among those under age 20 (18 percent); the highest rate was among those age 40 and older (51 percent).

Thirty-nine percent of the drivers were operating motorcycles they did not own, and they were less likely to be licensed than driver-owners (20 percent vs. 44 percent, OR = 0.31, CI = 0.26, 0.38). Driver-nonowners tended to be younger than driver-owners (63 percent were under age 25 compared with 47 percent of driver-owners; OR = 1.97, CI = 1.65, 2.34), but as shown in Figure 2, the differences in licensure rates between these two groups held, regardless of age (OR = 0.35, CI = 0.29, 0.43).

Among crash-involved drivers without valid licenses, 53 percent had a license to drive a passenger car but did not have a motorcycle endorsement, 31 percent did not have a license to drive any kind of motor vehicle, and 16 percent had suspended or revoked licenses.

Owner-Driver Pairs

Table 2 displays the percentage of validly licensed driver-nonowners by age, motorcycle owner license status, and the relationship between the driver and the owner. Older owners are defined as those who are more than 10 years older than the driver. Overall, in 56 percent of the 517 pairs, neither driver-nonowner nor owner was validly licensed. Valid driver licensure increased with driver age and with having a licensed owner. When owners were licensed, 27 percent of the drivers held valid licenses. When owners were unlicensed, only 14 percent of the drivers were licensed.

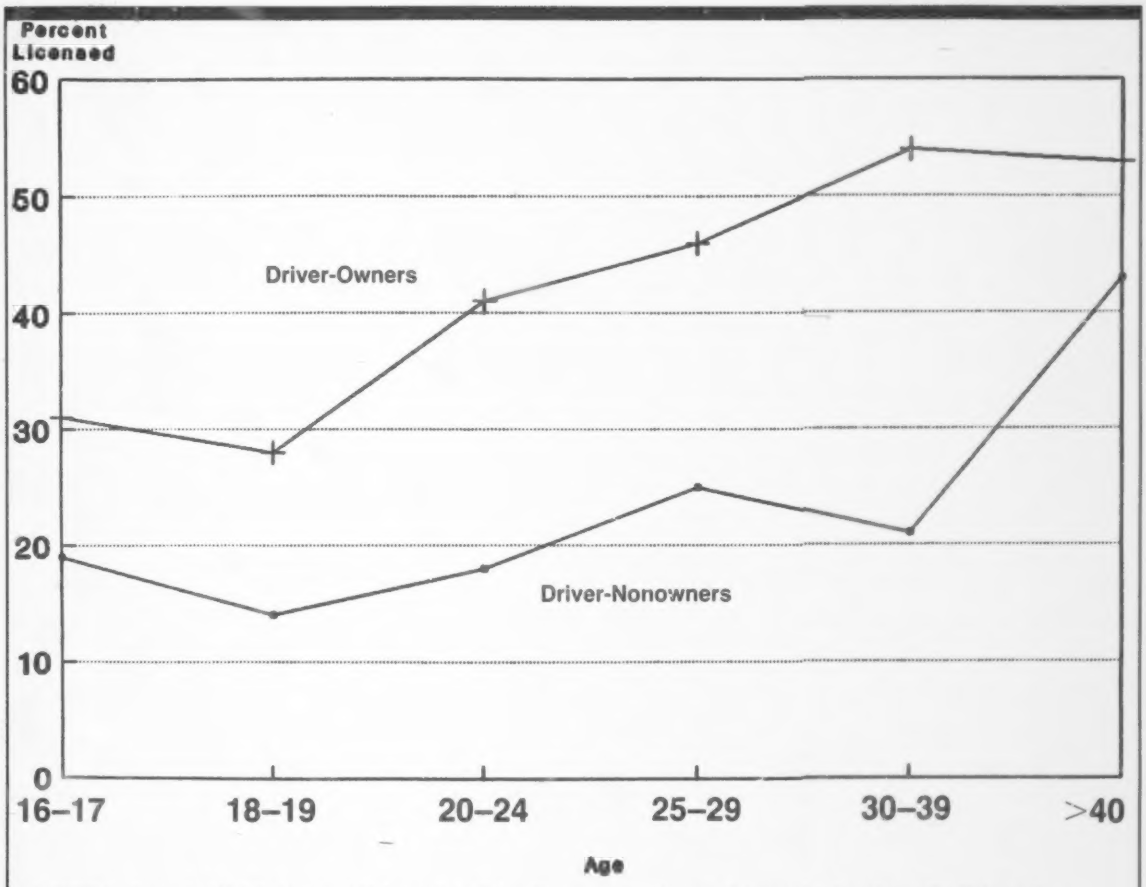

FIGURE 2—Percent of Validly Licensed Motorcyclists: Driver/Owners in Crashes vs. Drivers who do not own the Motorcycle

The data were analyzed using a log-linear model that included the three factors shown in Table 2 plus the interaction between motorcycle owner license status and the relationship between the driver-nonowner and the motorcycle owner. A greater proportion of drivers were licensed to operate a motorcycle if they were older and if the owner was licensed. More drivers were licensed if the owner was at least 10 years older than the driver and had the same last name or address as the driver, and fewer drivers were licensed when the owner was within 10 years of the driver's age and had a different last name and address.

Discussion

The proportion of unlicensed injured motorcycle drivers (67 percent) identified in this study is extraordinarily high compared with the proportion of fatally injured motor vehicle drivers (11 percent) in the US Fatal Accident Reporting System (FARS).[4] Our results also indicate that motorcycles owned by people without motorcycle licenses are more likely to be in crashes than motorcycles owned by people with valid motorcycle driving licenses. The results strengthen earlier, incomplete findings by Hurt and associates and FARS that most motorcyclists in crashes, especially young motorcyclists, are not validly licensed. In addition, those driving motorcycles they did not own were likely to be unlicensed, especially if the owner was also not licensed to operate a motorcycle.

The results also show that driver age, the use of someone else's motorcycle, and borrowing from an unlicensed owner are independent factors affecting valid licensure. Among young motorcyclists who crashed on motorcycles that were owned by other young and unlicensed motorcyclists, virtually none was validly licensed.

Unavailable data may alter somewhat the percentages presented. Licensure data were available for most of the drivers, but the driver's license status of only about 60 percent of the owners of motorcycles crashed by another operator and the random sample of owners of motorcycles not in crashes was known. This occurred usually because the name and address of the owner could not be matched with a name and address on the driver's license file. This linkage can fail for various reasons, such as a change of address by the owner. It is not known whether owners who could not be traced had a different percentage of valid licensure than those successfully traced.

Several countermeasures can be considered for reducing the crashes associated with invalidly licensed motorcycle owners and drivers. Requiring proof of valid licensure as a prerequisite for purchasing a motorcycle would reduce the extent to which owners and drivers are not

TABLE 2—Percent of Motorcycle Driver-Nonowners Validly Licensed by Owner Relationship to Driver, Driver Age, and Owner License Status

Owner Relationship to Driver	Owner Licensure Status	Driver's Age		
		16–19	20–24	25+
Age within 10 years Same name/address	Licensed	33[a]	35	50
	Unlicensed	12	13	13
Age within 10 years Different name/address	Licensed	5	18	13
	Unlicensed	0	5	14
>10 years older than driver Same name/address	Licensed	33[a]	67[a]	67[a]
	Unlicensed	28	53	33[a]
All others[b]	Licensed	67[a]	11[a]	12
	Unlicensed	6	6	25

[a] Based on fewer than 10 observations.
[b] All other driver-nonowner and owner pairs.

properly licensed. Motorcycle driving by invalidly licensed people might be reduced by stepping up enforcement of licensure laws and/or providing more stringent penalties for lack of licensure. Penalties against the owners of motorcycles driven by invalidly licensed drivers could deter owners from allowing such people to operate their motorcycles.

If applied, these measures could change the behavior of motorcycle owners and operators in one of two ways: these people can avoid sanctions either by obtaining the proper license or by not driving.

Measures that merely force licensure but do not change the amount of driving may have no effect on crashes. When existing licensure and training programs have been formally evaluated based on random assignment, the programs have not been shown to be effective in reducing crashes.[†,††] Thus, sanctions applied to unlicensed drivers and owners are more likely to be effective if they reduce driving than if they merely shift unlicensed driving to licensed driving. If the measures reduce exposure, they will reduce crashes, especially of young, novice, unlicensed drivers on borrowed bikes. ☐

Acknowledgments

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Alcohol Use and Abuse in Random Samples of Physicians and Medical Students

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ABSTRACT

Background. This study sought to resolve conflicting views about whether physicians are especially prone to alcohol abuse.

Methods. Using an anonymous, mailed questionnaire on substance use, we surveyed 500 physicians, 510 pharmacists, and 974 of their students. The physicians and pharmacists were selected randomly from the state society's membership lists, and students selected were from local school lists. Follow-up surveys were sent to nonresponders at two-week intervals.

Results. The physicians and medical students did not drink especially heavily and were no more vulnerable to alcoholism than were their counterparts in pharmacy and other professions. Physicians differed from pharmacists in their style of drinking (greater frequency, smaller quantity), but not in total amount of alcohol consumed. Drinking habits among physicians were not associated with medical specialty or type of practice, but were positively related to gender (males drank more than females) and to age (older doctors were more apt to qualify as heavy drinkers than were younger doctors).

Conclusions. Physicians were no more likely to abuse substances nonmedically than were other professionals. Any group in which alcohol use is nearly universal incurs a risk of abuse and impairment that cannot be ignored. (*Am J Public Health* 1991; 81:177–182)

Introduction

The authors previously presented evidence that many physicians, pharmacists, and their students have used controlled drugs for self-treatment and nonmedical purposes.[1] In his commentary, Lewis[2] cited the authors' failure to include alcohol use in their report. Some authors[3–5] have concluded that physicians are especially prone to alcoholism, while others[6–9] have concluded the opposite. Brewster[6] identified methodological flaws and contradictory findings in studies comparing physicians to other groups regarding cirrhosis mortality[10–13] and hospital admissions for alcoholism.[14–19] She concluded that surveys of physicians regarding alcohol use produce the most valid comparisons.[6,*] Our search of the literature revealed that few surveys have been reported to date,[7,8,20–25] and these have been limited by either small,[7,20,21] selective,[20,23] or nonrandom samples;[8,21,24] lack of anonymity for respondents;[21] incomplete measures;[27] minimal reporting of alcohol results;[22] or absence of comparable data on nonphysicians.[7,24,25] Studies of medical students suffered from similar limitations,[26] but recent studies have improved our knowledge substantially.[7,27–34]

This article presents a comprehensive picture of current and lifetime physician alcohol use and abuse from surveys of doctors and medical students, with comparative data on pharmacists, pharmacy students, and lawyers. The article also describes how physicians' drinking varies by medical specialty, type of practice, gender, and age.

Methods

The bulk of the data come from a previously described,[1] mailed, questionnaire survey (November 1984) of 500 physicians randomly sampled from the membership (8,400) of a state medical society, and 504 medical students randomly drawn from medical schools (combined enrollment of 1,438) in the same state. Approximately 73 percent of the state's physicians were society members in 1984. Comparative data come from a sample of 510 pharmacists randomly selected from the membership (1,270) of the state's pharmaceutical society and 470 pharmacy students randomly drawn from area schools (combined enrollment of 1,160). Each mailing packet contained a questionnaire, a letter assuring anonymity, and a post card with instructions to return it separately so that names could be removed from the follow-up mailing list. Second and third mailings and a reminder phone call to nonrespondents followed at two-

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[*] McAuliffe WE, Breer PE: Are physicians more susceptible to alcoholism and substance abuse than are other professionals? The con view. Paper presented at the Joint Meeting of the American Medical Society on Alcoholism and Other Drug Dependencies and the Research Society on Alcoholism, San Francisco, CA, April 22, 1986.

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TABLE 1—Drinking in the Last Year

	Physicians (n = 337)	Pharmacists (n = 312)	Medical Students (n = 381)	Pharmacy Students (n = 278)
Quantity/Frequency				
Mean drinks/month[a]	20.3	21.2	13.3[#]	15.1[*]
Mean drinking days/month	9.9	8.1[*]	5.3[#]	3.9[#]
Mean drinks/drinking day	1.7	1.9[*]	2.1[#]	2.9[*#]
Admitted Having Current Drinking Problem (%)	2	1	3	1

[a] Exceeds product of drinking days per month and drinks per day. The mean of ratios (products) equals the ratio of means only under special conditions.[38]

[*] Difference ($p < .05$) either between physicians and pharmacists or between medical students and pharmacy students, controlling for age, gender, and citizenship.

[#] Difference ($p < .05$) either between physicians and medical students or between pharmacists and pharmacy students, controlling for gender and citizenship.

week intervals. The Committee on the Use of Human Subjects in Research at the Harvard School of Public Health approved the procedures.

Measures of Drinking Behavior and Problems

Responding to fixed alternative items, subjects qualitatively characterized their drinking since entering college, recorded whether they currently or ever had a drinking problem, and how frequently they experienced specific dysfunctions due to drinking (Table 2). For analysis we divided dysfunctions into "minor" and "major." Subjects also reported how often they drank in the past year (frequency) and how many drinks they typically consumed on each occasion (quantity). One drink was defined as 12 oz of beer, 3.5 oz of wine, or 1 oz of liquor. From those quantity/frequency reports, the investigators constructed a typology of current drinking patterns using the cutoff for heavy drinking (61+ drinks per month) employed by other researchers.[35,36]

Alcohol Abuser and Potential Abuser Operationally Defined

"Alcohol abuse" included both pathological use and significant dysfunction due to drinking, in accordance with DSM-III criteria.[37] "Pathological use" meant an average of more than three drinks per day in the past year, characterizing self as a lifetime "problem" drinker, or admitting a past or current drinking problem. "Significant dysfunction" was operationalized as a score of at least three on a scale of *minor* dysfunctions *or* a score of at least one on a scale of *major* dysfunctions. Scores were computed by assigning zero for a response of "never," one for "once or twice," two for "sometimes," and three for "often," and then summing across the four items in each scale.

A "potential abuser" had to report a combination of "heavy" alcohol use and "some dysfunction" due to drinking. "Heavy use" meant either an average of more than two drinks per day in the past year, or self-characterization as a lifetime heavy drinker. "Some dysfunction" was defined as at least one minor or major dysfunction due to drinking.

Statistical Methods

The methods used for comparing sample statistics included 95 percent confidence intervals and significance tests based on the t and chi-square distributions, multiple regression, and multiple logistic regression, depending on the number and measurement level of variables. The standard error calculations assumed infinite populations; all tests were two-tailed.

The Wyshak Sample

Unpublished quantity/frequency data will also be presented from a second survey of physicians and lawyers described elsewhere by Wyshak, *et al.*[22] This second physician sample was drawn randomly from the Department of Public Health's list of registered physicians in the same state five years before.

Results

Survey Response

After unlocatable and deceased respondents were removed from the four samples, the response rates were 70 percent for physicians, 78 percent for medical students, 76 percent for pharmacists, and 67 percent for pharmacy students. The figures for the two professional samples compared favorably with Wyshak's survey.[22] A few questionnaires returned by nonpracticing professionals and students who had left school were excluded to produce final samples of 337 physicians, 312 pharmacists, 381 medical students, and 278 pharmacy students. Responding physicians did not differ significantly from nonrespondents with respect to specialty, type of practice, sex, or geographical distribution. Only data on sex were available for the other three samples; medical school females responded more often than males (83 percent vs 75 percent, respectively), but no difference was found among pharmacists or pharmacy students. For the survey as a whole, how soon a respondent returned his/her questionnaire did not correlate with number of drinks in the past year, lifetime pattern of drinking, or reporting having ever had a drinking problem. However, doctors who reported having ever had a drinking problem tended to return their questionnaires later rather than sooner ($r = .09$; CI = +.04, +.14).

Despite the educational differences between the physicians and pharmacists, the samples were nearly identical in age (mean of 46 for both), gender (85 and 84 percent male respectively), and US citizenship (97 and 99 percent respectively). More pharmacists (79 percent) than physicians (66 percent) attended religious services. Medical students were older (25 vs 22 years), more often males (59 vs 44 percent), less religious, and more often American (99 vs 91 percent) than were pharmacy students. When appropriate, these variables are controlled in subsequent analyses, but since the samples were so similar, the adjustments made a difference only between practitioners and students (age was not controlled).

Drinking in the Last Year

There is no consistent evidence that physicians or medical students currently drink more than their counterparts in pharmacy (Table 1). While physicians and medical students reported drinking more *frequently* than the pharmacy samples, the pharmacy samples reported consuming greater *quantities* per drinking episode. In both medicine and pharmacy, practitioners drank more often than students but consumed less per episode. These zero-order differences remained when demographics were controlled.

There were only minor differences in current patterns of drinking among the four samples. Most respondents (e.g., 86 percent of doctors) in all four groups were

TABLE 2—Dysfunction Due to Drinking (% Ever)[a]

Has your drinking ever caused you to:	Physicians (n = 337)	Pharmacists (n = 312)	Medical Students (n = 381)	Pharmacy Students (n = 278)
Minor Dysfunction				
Get behind in your work/studies	1	4	9[c]	12[c]
Call in sick or be late for work/school	4	5	15[c]	14[c]
Have trouble getting along with people	4	3	6	4
Worry that you might be using too much or too often	15	8[b]	13	9
One or more minor dysfunctions	17	11	22	21[c]
Major Dysfunction				
Seriously consider suicide	1	0	1	1
Have an auto accident or other type of accident	2	3	4	2
Provide less than your best patient care/get poor grades	3	2	2	6
See a psychiatrist, psychologist, social worker, or counselor	3	2	1	1
One or more major dysfunctions	5	5	5	8

[a] Item response options were "never," "once or twice," "sometimes," and "often." All percentages here are for "once or twice" or greater.

[b] Difference ($p < .05$) between either physicians and pharmacists or medical students and pharmacy students.

[c] Difference ($p < .05$) between either physicians and medical students or pharmacists and pharmacy students.

either light or moderate drinkers. The primary difference between the medical and pharmacy samples was in the percentage of abstainers (4 percent of doctors, 5 percent of medical students, 10 percent of pharmacists, and 11 percent of pharmacy students). Currently abstaining practitioners had a past or have a current (nonactive) drinking problem in some cases (one-third of physician abstainers, one-seventh of pharmacist abstainers). The major difference between practitioners and students was in the percentage of heavy drinkers (10 percent doctors, 12 percent pharmacists, 6 percent both medical and pharmacy students). When the amount of drinking was dichotomized at 61 drinks per month (cutoff for heavy drinking), the percentage difference between practitioners and students was estimated by logistic regression to be 5.7 (95 CI = 2.4, 8.9); that difference declined to 3.4 (0.1, 6.8) when gender and citizenship were included.[39]

Few respondents admitted to having a current drinking problem (from 1 to 3 percent; Table 1). There was, however, evidence of possible denial among heavy drinkers. While most of the respondents who admitted to a drinking problem also reported drinking very heavily (91+ drinks per month), the reverse was not true. Of the 13 physicians who reported drinking very heavily, only four saw themselves as having a current drinking problem, even though some of them admitted averaging over six drinks a day. Among pharmacists, only two of 17 very heavy drinkers reported a current problem. Among students, the figures were five of nine in medicine and zero of seven in pharmacy.

The Wyshak, *et al*, sample reported similar levels of drinking in the last year. With females eliminated to facilitate comparison, the mean of drinks per episode was almost identical (1.8 vs 1.7), and slightly more of Wyshak's sample reported heavy drinking (15.6 vs 12.4). Wyshak's physicians, however, averaged more drinking days per year (152 vs 126) than did ours ($p < .05$).

Lifetime Drinking Behavior and Problems

When asked to characterize their drinking pattern since entering college, most respondents (e.g., 91 percent of physicians) also described themselves as either light or moderate drinkers. Physicians differed significantly from pharmacists primarily in the percentage of abstainers (6 percent doctors, 12 percent pharmacists) as did medical students (7 percent) from pharmacy students (14 percent). There were no differences across the samples in the percentage of lifetime heavy or problem drinking. In all four samples, 4 percent of respondents admitted having ever had a drinking problem since entering college.

Dysfunction Due to Drinking

Although one in six physicians had worried at least once that he or she might be drinking too much, few reported a major dysfunction due to drinking (Table 2). Three percent of the physicians indicated that at least "once or twice" drinking had caused them to give less than their best patient care, and 3 percent had sought professional treatment for their drinking at some time in their careers. All told, 17 percent of physicians had ever experienced at least one dysfunction, while 10 percent had experienced two or more.

Physicians were more apt to worry about their drinking then were pharmacists (ratio of 1.9:1), and students were more likely than practitioners to report at least one minor dysfunction (ratio of 1.8:1). Most of the difference between practitioners and students, however, was in the two items that were worded differently for the two groups (work vs school).

Lifetime Abusers and Potential Abusers

Although physicians and medical students had slightly smaller percentages of combined abusers and potential abusers than the pharmacy samples (Figure 1), none of the samples differed significantly from the others on abuse, potential abuse, or the sum of the two. Controlling for gender and citizenship did not alter that finding. Of the 4 percent of physicians who abused alcohol at some time in their lives, half reported either no drinking or moderate drinking in the past year; the other half were still drinking heavily.

Subject Characteristics and Alcohol Use

Alcohol use was not related to medical specialty, type of practice (solo, group, and so on), citizenship, or religiosity, but was associated with both gender and age. Male physicians averaged 10.5 drinking days per month in the last year to only 6.5 for female physicians (CI for difference = 1.2, 7.0); male physicians also consumed more drinks per occasion (1.7 vs 1.2; CI for difference = 0.2, 0.8). However, like the male physicians, 4 percent of the female physicians qualified as ever being alcohol abusers, primarily on the basis of having a past drinking problem.

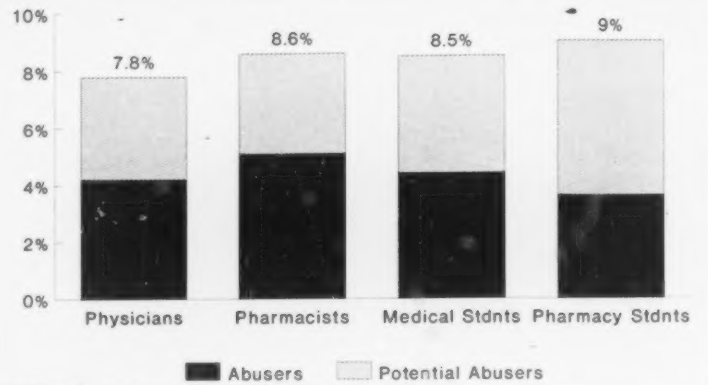

FIGURE 1—Lifetime abusers and potential abusers.

Abusers = pathological use plus impairment. Potential Abusers = pathological use plus minor impairment.

The gender difference in current drinking behavior was equally striking among pharmacists, but not among the student groups. Among medical students, males drank more than females in the last year, averaging 15.2 drinks per month to 10.4 for the females (CI for the difference = 0.8, 9.0). The sex difference, however, was only about a third as large as that for physicians.

Whereas gender bears the same relationship to drinking among our four samples as it does in the US population as a whole, the relationship between age and drinking is reversed (Figure 2, where females have been removed from all samples). Heavy drinking *decreases* with age for US males in general[35] (a finding confirmed in cross-sectional and cohort studies[40]), but it *increases* with age for both physician samples. Like physicians, pharmacists begin drinking much less than do US males, but jump quickly to a level close to that of the US population and remain at that level thereafter. Lawyers start somewhat lower than US males, peak sharply in their forties, and decline to a level slightly higher than physicians in their fifties and sixties.

Discussion

None of the present findings from our sample or the Wyshak, *et al*, sample indicates that physicians or medical students are especially prone to heavy drinking, alcohol problems, or alcohol abuse. The unique relationship between age and heavy drinking in these medical samples is confirmed by small surveys of residents and young physicians by the present authors[7] and another team in the same state,** and by physicians in another country.[25] It was also supported by data from a 20-year longitudinal study comparing a small sample of physicians with controls.[20] Analysis of data on job and life stress from this present study and our previous investigation[7] indicated that the association between physician age and drinking persists even after stress was controlled.

Several lines of argument support the validity of our survey methodology.[6] Recent reviews of the validity of self-report alcohol consumption data have found that they are generally valid.[41–44] Eight studies of clinical populations (i.e., individuals with a drinking problem) revealed "a high degree of agreement between patients and collaterals (family members) with no consistent direction of error."[41] Five nonclinical population surveys "yielded somewhat similar findings."[41]

There is conflicting evidence regarding the possible biasing effect of survey nonresponse. One study of physicians[45] found that attaining a survey completion rate higher than that found here had little effect on the results. Another investigation[46] reported no systematic relationship between probability of response and amount of alcohol consumption. Two other studies (one on cigarette use[47] and another on alcohol use in Sweden[42]) found that heavy users were more likely than light users to be nonrespondents. The close match between our sample and the medical society's members, and the generally weak correlations between drinking measures and promptness of response to our survey by doctors, suggests that any bias in the present study is probably small.

While severe alcoholics who are no longer practicing medicine may have been omitted from the sampling list, research tells us that impaired physicians rarely drop out of medicine or do so only briefly.[48] During 1984, the state from which the

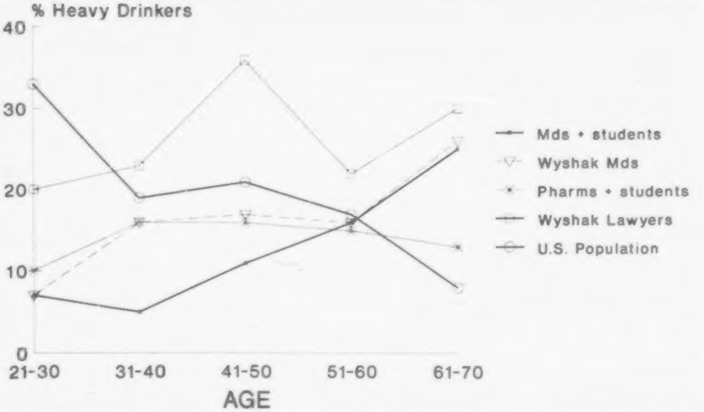

FIGURE 2—Heavy drinking by male doctors, pharmacists, and lawyers, according to age.

Note: US data from Clark and Midanik.[35]

**Gortmaker SL, Cheung L, Cleary P, Lampert S, Peterson N, Wechsler H: Results of the 1986 Harvard Health Survey at the Harvard School of Public Health, unpublished.

samples were drawn revoked the licenses of fewer than five physicians per 10,000 for all reasons.[49]

If the prevalence of alcohol use and abuse among physicians has been underestimated because of nonrespondents, that bias is probably no less true of pharmacists or medical students and pharmacy students. Since there is no reason to suspect *differential* bias, the results showing physicians and medical students to be no more vulnerable to alcoholism than pharmacists and pharmacy students are most likely valid. However, because of the nonresponse bias that has sometimes been found in surveys,[43,45,47] figures on the absolute prevalence of alcoholism for physicians and nonphysicians alike should be considered conservative.

Although the weight of evidence here and in previous studies[7,8,22,23,31,50,52] indicates that physicians and medical students are no more apt to abuse alcohol than are members of other professions, it is of some importance to the medical profession that, given the critical nature of their work, physicians are as vulnerable as their peers. The importance of the impaired physicians movement remains as an effective and humane model for handling problems of addiction. The findings reported here can best be used to remind us all that in any group where alcohol use is nearly universal and use rates are more than nominal, the risk of abuse and impairment cannot be ignored. ☐

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Comments Sought on Product Safety Aspects Examination

The Board of Certified Safety Professionals (BCSP) has offered the Product Safety Aspects Examination since October 1981. In that nine-year period, very few candidates for certification have selected this specialty examination. Currently, there are only 25 Certified Safety Professionals certified in Product Safety Aspects.

Maintaining a good quality examination is costly. The number of candidates taking the Product Safety Aspect Examination has been so small that the fee income from the candidates who take it does not cover the costs associatied with its development and maintenance.

Because of the limited interest and the cost of maintaining the examination, BCSP is considering whether or not to offer Product Safety Aspects as a specialty. In making this decision, the Board is attempting to determine if the demand for the examination will change in the future or if there are special circumstances that would justify its continutation even with a small number of candidates. Examples of factors which could result in increased demand for the examination are changing regulatory requirements or increasing employer/client emphasis on certification in Product Safety Aspects.

To assist in making this decision, the BCSP is soliciting comments and opinions from all interested parties. Comments on this issue may be submitted to: Micharel K. Orn, CSP, Executive Director, Board of Certified Safety Professionals, 208 Burwash Avenue, Savoy, IL 61874-9510; Tel: (217) 359-9263; Fax: (217) 359-0055.

Effects on Serum Lipids of Adding Instant Oats to Usual American Diets

ABSTRACT

This study was designed as a test of the serum lipid response and dietary adaptation to recommended daily inclusion of instant oats in an otherwise regular diet. Hypercholesterolemic adults were randomly assigned to a control or intervention group. Participants in the intervention group were given packages of instant oats and requested to eat two servings per day (approximately two ounces dry weight), substituting the oats for other carbohydrate foods in order to maintain baseline calorie intake and keep weight stable. Serum lipids were measured in blood collected by venipuncture at baseline, four weeks, and eight weeks. Baseline mean total cholesterol (TC) levels were 6.56 mmol/L and 6.39 mmol/L for intervention and control groups, respectively. After eight weeks, mean serum total cholesterol of the intervention group was lower by −0.40 mmol/L, and mean net difference in TC between the two groups was 0.32 mmol/L (95% CI: 0.09, 0.54). Low-density lipoprotein-cholesterol was similarly reduced with mean net difference of 0.25 mmol/L (95% CI: 0.02, 0.48) between the two groups. Mean soluble fiber intake increased along with slight self-imposed reductions in mean total fat, saturated fat, and dietary cholesterol intake in the intervention group. Neither group changed mean body weight. Daily inclusion of two ounces of oats appeared to facilitate reduction of serum total cholesterol and LDL-C in these hyperlipidemic individuals. (*Am J Public Health* 1991; 81:183–188)

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Introduction

Elevated serum cholesterol is an established risk factor for coronary heart disease (CHD).[1,2] About 1.5 million Americans have heart attacks each year. Evidence is extensive that lowering blood cholesterol reduces risk of heart attack, and slows, stops and even reverses atherogenesis.[2-7] The report of the National Cholesterol Education Program (NCEP) Adult Treatment Panel states that diet is the cornerstone of treatment for high blood cholesterol.[8] Epidemiological studies, controlled clinical trials, animal experimental data, and autopsy studies demonstrate that diet and plasma lipids are causally related.[9] Dietary fatty acids, dietary cholesterol, weight change, and water soluble fiber have all been observed to affect serum cholesterol.[10-12]

These and other studies have generated growing public interest in appropriate foods to help lower blood cholesterol. Physicians and other health professionals recommend reducing intake of total fat, saturated fatty acids, and cholesterol to maximize blood cholesterol lowering. A relatively simple step toward improving dietary behavior may be emphasis on daily inclusion of carbohydrate foods high in water soluble fiber, such as oats, to help displace some of the saturated fat and cholesterol containing foods. By advocating foods to eat rather than focusing solely on foods to restrict, dietary adherence and nutrient adequacy may be better achieved. To explore the efficacy and feasibility of this approach, this study was designed to measure the dietary changes and biochemical response of including moderate daily amounts of instant oats in the diet of free-living, hyperlipidemic men and women.

Methods

Participants

Men and women volunteers were recruited from a financial institution in Chicago. Capillary blood cholesterol levels were measured with use of the Reflotron* desk-top instrument, to confirm hypercholesterolemic status of individuals previously screened by the company and found to have serum cholesterol levels above 5.20 mmol/L. Eligibility criteria included: availability and willingness to follow study protocol, attendance at all data collection visits and completion of all food records, not on lipid-lowering drugs or anti-hypertensive medication, not diabetic, not pregnant or lactating, not greater than 1.5 times desirable body weight (1959 Metropolitan Life Insurance Weight Tables as standards), and not on a weight-loss diet. All participants signed informed consents. Participants were required to complete a three-day food record before the baseline data collection visit.

Data Collection

Individuals were randomized to one of two groups, stratified by sex and pre-

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Editor's Note: See also related editorial p 159—this issue.

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*Boehringer-Mannheim, Indiana.

TABLE 1—Baseline Means and Standard Deviations for Group 1 and Group 2

	Group 1 Intervention	Group 2 Control
	n = 42	n = 38
Male/Female	21/21	19/19
Age (years)	42.9 ± 13.5	42.1 ± 11.9
Age Range (years)	25.0–76.2	22.2–66.9
Serum Total Cholesterol mmol/L	6.56 ± 0.82	6.39 ± 0.88
Low Density Lipoprotein Cholesterol mmol/L	4.58 ± 0.81	4.61 ± 0.73
Body Weight (kg)	76.2 ± 15.1	75.7 ± 13.4
Height (cm)	169.9 ± 10.8	169.8 ± 8.9
Body Mass Index (BMI)(kg/m^2)	26.2 ± 3.4	26.2 ± 3.8
Blood Pressure (mm Hg)	128/80 ± 14/10	129/79 ± 20/8

screen cholesterol level, above or below 6.34 mmol/L, prior to baseline visit. Group 1 was the treatment group and was asked to consume two packets (56.7 grams dry weight) of instant oats per day. This represented 5.6 grams of total dietary fiber per day, of which 3.4 grams was insoluble fiber and 2.2 grams was soluble fiber. Group 2 served as the control group and was asked to maintain usual intake throughout the study. Food records, height, weight, blood pressure, and serum blood lipids were measured at baseline and two subsequent visits, after four and eight weeks. Biochemical variables assessed were serum total cholesterol, triglycerides, low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), and very low density lipoprotein cholesterol (VLDL-C). Total cholesterol, HDL-C, and triglycerides were measured enzymatically (Technicon Autoanalyzer)** VLDL-C and LDL-C were calculated from the other lipids.[13] Body mass index (BMI) was calculated as weight (without shoes), measured in kilograms on a beam balance scale, divided by height in meters squared (kg/m^2). Blood pressure was measured twice by trained, certified technicians using a standard sphygmomanometer.

To avoid weight change, the intervention group was briefly instructed how isocalorically to substitute oats for other carbohydrate foods in their diet. Choice of preparation methods, time of day to consume the oats, and whether the packets of oatmeal should be eaten together or at separate times were left to the participants. No other dietary changes were advised. The intervention and control groups met separately.

Analyses

A two-tailed, two sample t-test was used for the analyses. The computer software program SPSS[14] was used.

Split samples of blood were analyzed for 10 percent of participants for quality control. Technical error was calculated by the formula:

$$TE=\sqrt{\sum_{i=1}^{N} d_i^2/2N},$$

where d_i is the difference between the ith pair of values for a person and N is the number of pairs; technical error divided by group mean × 100 was used to estimate percentage error. Food records were edited and coded by trained, certified nutritionists at the Nutrition Coordinating Center in Minneapolis. The National Heart, Lung and Blood Institute (NHLBI) nutrient data base (tape no. 16) was used for the nutrient analyses.[15] Blinded duplicates of 10 percent of all food records were sent for recoding and analysis for external quality control.

Subgroup analyses were performed comparing observed versus predicted cholesterol responses between groups based on change in Keys Scores. The Keys Score: $1.35 \times (2\ \Delta S - \Delta P) + 1.5\ \Delta Z$—where ΔS stands for the difference between the two diets in calories for saturated fatty acids (SFA), ΔP is the percent of calories for polyunsaturated fatty acids (PUFA), and ΔZ is the difference in the square root of dietary cholesterol in milligrams per 1,000 calories per day—can be used to predict group change in serum cholesterol level.[16] Analysis of covariance was used to measure mean changes in serum cholesterol adjusted for study group, sex, body mass index, and baseline cholesterol.[6]

Results

Prescreen total cholesterol levels were measured on 245 individuals. Of those, 111 met eligibility criteria, signed consents, and were randomized prior to the baseline visit. Failure to attend the baseline visit with a completed food record constituted a drop out. In all, 80 individuals completed all data collection visits; 14 were dropped from the Intervention Group and 17 from the Control Group. The majority of dropouts (18) did not bring food records and/or did not attend the baseline visit; other reasons: ill (5), wanted to lose weight (6), pregnant (1), and "oat product was too sweet" (1).

Mean age for the total cohort was 42 years (Table 1). There were no differences between the two groups in the characteristics measured including mean lipid levels.

As presented in Tables 2 and 3, after four weeks of intervention, Group 1 mean cholesterol was lower by 0.28 mmol/L and mean net difference, or the difference of the difference, between groups was 0.20 mmol/L. After eight weeks, mean net difference in total cholesterol was 0.32 mmol/L (95% CI = 0.09, 0.54) and in LDL-C was 0.25 mmol/L (95% CI = 0.02, 0.48). There were no significant differences between the groups in HDL-C or triglycerides.

Technical errors for serum lipid measurements were: total cholesterol, 1.6 percent, HDL-C, 2.7 percent; and triglycerides, 3.2 percent.

Reported dietary intake data are summarized in Table 4. At visit 3, Group 1 reported slightly decreased total fat, dietary cholesterol, and saturated fat. For the control group, there were slight increases in these dietary values. These opposite changes across groups resulted in an absolute difference in Keys Score of 5.31 (p = 0.039) from visit 3 to visit 1. Intervention group food records indicated increased intake of total, soluble, and insoluble fiber, iron, calcium, vitamin B_6, folacin, niacin, magnesium, and retinol. Group 1 reported consuming an average of 1.9 packets (54 grams) of instant oatmeal each day. This represented 5.3 grams of total dietary fiber of which 3.2 grams was insoluble fiber and 2.1 grams was soluble fiber. There were no reports of side effects from eating the oats.

**Technicon, New York.

TABLE 2—Group Means and Standard Deviations at Visits 1, 2, and 3 for Serum Lipids, Lipoproteins and Blood Pressure

Variables	Visit 1 Baseline	Visit 2 4 Weeks	Visit 3 8 Weeks
Total Cholesterol			
Group 1 mmol/L	6.56 ± 0.82	6.28 ± 0.92	6.15 ± 0.86
Group 2 mmol/L	6.39 ± 0.78	6.32 ± 0.84	6.30 ± 0.82
LDL-C			
Group 1 mmol/L	4.58 ± 0.81	4.24 ± 0.87	4.16 ± 0.83
Group 2 mmol/L	4.61 ± 0.73	4.39 ± 0.75	4.44 ± 0.77
HDL-C			
Group 1 mmol/L	1.29 ± 0.34	1.36 ± 0.28	1.28 ± 0.29
Group 2 mmol/L	1.26 ± 0.32	1.35 ± 0.26	1.30 ± 0.25
VLDL-C			
Group 1 mmol/L	0.70 ± 0.50	0.68 ± 0.42	0.71 ± 0.48
Group 2 mmol/L	0.51 ± 0.23	0.58 ± 0.28	0.56 ± 0.24
Triglycerides			
Group 1 mmol/L	1.52 ± 1.09	1.48 ± 0.92	1.54 ± 1.04
Group 2 mmol/L	1.12 ± 0.51	1.26 ± 0.61	1.22 ± 0.53
Blood Pressure (mm Hg)			
Group 1	127.9/80.3 (± 13/10)	121.8/80.8 (± 11/8)	123.5/77.0 (± 14/11)
Group 2	129.1/79.1 (± 20/8)	124.8/80.0 (± 11/8)	124.2/77.2 (± 13/9)

Group 1 = Intervention (oats), n = 42.
Group 2 = Control, n = 38.

Mean group difference in body mass index from visit 1 to visit 3 was not significant (Table 4). Average weight change from visit 1 to visit 3 was less than one pound with a slight decrease in Group 1 and increase in Group 2. Blood pressure changes also were not significant (Table 2).

Subgroup analyses explored possible differences in cholesterol response according to baseline median levels of serum total cholesterol, BMI, Keys Score, and sex (data not shown). Greater reductions in total cholesterol were observed among those individuals above the baseline median serum total cholesterol level of 6.34 mmol/L and below the median BMI of 26.17. Men and women in the intervention group experienced similar reductions in serum total cholesterol. In regression analysis to adjust for baseline total cholesterol, sex, BMI, and study group (Table 5), serum total cholesterol at visit 3 was significantly different between the two groups. Changes in serum cholesterol from visit 1 to visit 3 were also significantly different between the two groups, independent of sex, changes in BMI, and the baseline serum cholesterol.

Discussion

In this study, consumption of a moderate amount of instant oats in the daily food pattern fostered blood cholesterol lowering in hyperlipidemic individuals. The data suggest that dietary adaptation to the practice of regularly eating oats potentiates favorable effects on blood total and LDL-cholesterol levels as well as on nutritional status by reducing intake of total fat, saturated fat, and cholesterol without weight gain and improving intake of commonly deficient nutrients, i.e., iron, calcium and vitamin B_6. Participants appear to have, at least in part, substituted oats for other carbohydrate foods isocalorically, rather than simply adding oats to the baseline intake. Proposed mechanisms for the effect of oats relate to soluble fiber's capacity to bind bile acids and interfere with fat absorption, to increase fecal excretion of bile acids affecting hepatic secretion of lipoproteins and to ferment colonic bacteria, thus forming gases and short chain fatty acids and affecting hepatic cholesterol synthesis.[11,17]

Our group has previously reported that in a free living, normolipidemic population, 2 oz. (56 grams) of oatmeal or oat bran led to additional decreases in serum cholesterol of 4.2 to 5.3 mg/dl (adjusted for the reduction in the control group) over what was attributed to dietary fat and cholesterol modification.[18] This finding was confirmed by a follow-up study where the addition of 2 oz. of oatmeal decreased serum cholesterol 4.7 mg/dl more than what was achieved by a fat-modified diet alone.[19] Subgroup analysis further showed greater reductions in participants with higher baseline serum cholesterol levels.[19] Other intervention studies in free-living, hypercholesterolemic individuals have shown that one cup of oat bran plus five oat bran muffins daily (100 grams oat bran) induced a significant decrease in plasma cholesterol.[20]

A review of intervention studies in this area noted that addition of soluble fiber from oats, oat bran, legumes, pectin, guar, or locust bean gums has been reported to reduce plasma total cholesterol by 6–19 percent.[10] Particularly in hypercholesterolemic individuals, addition of oats has been reported to induce total cholesterol and LDL-C reduction.[21,22] The combination of a fat modified diet plus regular intake of oat bran by hyperlipidemic individuals was also shown to be as effective in cholesterol lowering as cholestyramine resin or colestipol with fewer side effects and less cost.[23]

More recently, Swain, *et al*,[24] reported blood cholesterol reductions of 7 to 8 percent in free-living, normolipidemic individuals (baseline mean serum cholesterol of 4.8 mmol/l) who consumed 100 gram supplements of oat bran or wheat cereal over six weeks in a crossover design study. The supplements were consumed in the form of muffins or entrees representing 35.6 percent (oat bran) and 40.8 percent (wheat cereal) of mean caloric intake reported during the two study periods. The authors concluded that isocaloric substitution of either oat bran or wheat for other carbohydrates produced similar blood cholesterol lowering effects in these normolipidemic individuals.[24] It was further suggested that previous studies including similar quantities (100 grams per day or more) of oat bran may have simultaneously induced quantitative and qualitative shifts in fat intake through replacement with oat bran and that these shifts were more directly responsible for

TABLE 3—Mean Group[a] Differences ± Standard Deviations for Serum Lipids

	V2 − V1 (Baseline—4 weeks)				V3 − V1 (Baseline—8 weeks)			
Serum Lipid	Group 1	Group 2	Net Diff V2 − V1	95% CI	Group 1	Group 2	Net Diff V3 − V1	95% CI
Total cholesterol mmol/L	−0.28 ± 0.59	−0.07 ± 0.50	0.20	−0.04, 0.45	−0.40 ± 0.55	−0.09 ± 0.43	0.32	0.09, 0.54
LDL-C mmol/L	−0.33 ± 0.68	−0.22 ± 0.42	0.11	−0.14, 0.36	−0.42 ± 0.58	−0.17 ± 0.42	0.25	0.02, 0.48
HDL-C mmol/L	0.07 ± 0.16	0.09 ± 0.19	0.02	−0.06, 0.10	−0.00 ± 0.18	0.04 ± 0.20	0.04	−0.04, 0.13
Triglycerides mmol/L	−0.04 ± 0.56	0.13 ± 0.29	0.17	−0.03, 0.37	0.02 ± 0.52	0.09 ± 0.37	0.07	−0.13, 0.27

[a] Group 1 = Intervention (oats), n = 42,
Group 2 = Control, n = 38.
*p <0.05
**p <0.01

TABLE 4—Baseline[a] Group[b] Means, Standard Deviations and Visit 3 Differences in Nutrient Intake from 3-Day Food Records

	Baseline Means		Difference V3 − V1		Difference
Dietary Factor	Group 1	Group 2	Group 1	Group 2	Group 1 − Group 2
Calories	1909.5 ± 465.0	2007.4 ± 519.0	76.2 ± 537.0	13.9 ± 560.5	62.4
Protein (%kcal)	17.0 ± 3.0	16.0 ± 2.7	−0.90 ± 4.0	−0.03 ± 3.5	−0.9
Carbohydrate (%kcal)	44.6 ± 7.1	44.6 ± 8.2	2.7 ± 7.0	−1.4 ± 7.6	4.00*
Total Fat (%kcal)	36.8 ± 6.6	37.0 ± 6.9	−0.20 ± 7.0	2.8 ± 6.4	−2.9*
SFA (%kcal)	12.6 ± 2.6	12.6 ± 3.0	−0.50 ± 3.0	0.93 ± 3.2	−1.4*
MFA (%kcal)	13.8 ± 2.9	13.6 ± 2.9	0.04 ± 3.3	1.6 ± 2.9	−1.6*
PFA (%kcal)	7.4 ± 2.4	7.8 ± 2.4	0.27 ± 2.7	0.12 ± 2.6	0.2
P:S Ratio	0.61 ± 0.2	0.66 ± 0.3	0.08 ± 0.30	−0.04 ± 0.3	0.1
Keys Score[c]	41.5 ± 9.3	41.1 ± 10.4	−2.4 ± 10.8	3.1 ± 12.3	−5.3*
Sodium (mg)	3235 ± 777	3371 ± 930	284 ± 1085	154 ± 1150	130.0
Cholesterol (mg)	264.8 ± 116.3	284.7 ± 131.5	−8.6 ± 158.9	23.9 ± 176.6	−32.5
Total Fiber (gm)	14.5 ± 5.2	16.0 ± 7.1	3.5 ± 4.8	−0.78 ± 5.6	4.2***
Soluble Fiber (gm)	5.2 ± 1.9	5.5 ± 2.3	1.4 ± 1.8	−0.48 ± 1.9	1.8***
Insoluble Fiber (gm)	8.6 ± 3.5	9.3 ± 4.5	2.2 ± 3.4	−0.07 ± 3.9	2.3**
Alcohol (%kcal)	2.5 ± 4.3	3.4 ± 4.4	0.67 ± 3.3	−1.4 ± 3.7	2.1
BMI (Kg/m^2)	26.2 ± 3.4	26.2 ± 3.8	−0.1 ± 0.56	0.1 ± 0.6	0.2
Thiamin (mg)	1.6 ± 0.7	2.5 ± 3.2	0.7 ± 1.6	−0.4 ± 4.3	1.0
Riboflavin (mg)	1.8 ± 0.9	2.4 ± 2.4	0.3 ± 1.5	0.5 ± 2.4	0.3
Niacin (mg)	21.7 ± 8.3	27.5 ± 22.3	4.9 ± 12.0	−5.1 ± 20.8	10.0**
Folic Acid (mcg)	276.2 ± 153.0	286.9 ± 145.3	167.1 ± 208.6	−17.1 ± 134.6	184.3***
Vitamin B$_6$ (mg)	1.9 ± 0.9	2.1 ± 1.3	0.6 ± 1.3	−0.3 ± 1.1	0.9**
Vitamin B$_{12}$ (mcg)	6.5 ± 7.2	5.5 ± 3.4	−1.1 ± 7.4	1.9 ± 7.7	2.9
Pantothenic Acid (mcg)	5.2 ± 3.4	6.0 ± 4.8	0.02 ± 3.9	−1.1 ± 4.6	1.1
Calcium (mg)	764.4 ± 385.8	729.2 ± 280.7	172.9 ± 356.3	9.7 ± 250.2	163.2*
Iron (mg)	15.9 ± 8.7	14.7 ± 4.8	11.9 ± 12.7	1.0 ± 6.4	10.9***
Zinc (mg)	12.0 ± 4.5	12.1 ± 7.1	1.2 ± 7.8	0.9 ± 7.6	0.3
Magnesium (mg)	274.8 ± 87.5	291.4 ± 102.6	34.7 ± 96.5	−13.9 ± 107.7	48.6*

[a] Visit 1 = baseline
[b] Group 1 = Intervention (oats), n = 42
Group 2 = Control, n = 38
[c] Keys Score = $1.35 \times (2\Delta S - \Delta P) + 1.5\Delta Z$
Where ΔS is the change in percentage of calories for SFA, ΔP is the change in percentage of calories for PUFA and z is square root of dietary cholesterol in milligrams per 1,000 calories per day.
*p ≤ .05
**p ≤ .01
***p ≤ .001

the observed serum cholesterol reduction than any effect of the oat bran itself. Demark-Wahnefried, *et al*,[25] similarly reported that both fat-modified and oat-bran enhanced diets lowered serum cholesterol by 10-17 percent among free-living, hyperlipidemic individuals (group mean baseline serum cholesterol level was 7.15 mmol/l). Relatively small sample sizes, differences in baseline blood cholesterol levels, differences in dietary assessment methodologies and incomplete nutrient data bases (lacking soluble versus insoluble fiber data) have made meaningful comparisons between such studies difficult.

TABLE 5—Regression Coefficients for Models of Visit 3 Total Serum Cholesterol (mg/dl) and Change in Total Serum Cholesterol (Visit 3 – Visit 1).

Dependent Variable = Visit 3 Total Cholesterol

Independent Variable	Coefficient	S.E. Coefficient
Group (0 = Control, 1 = Intervention)	−11.25	4.33
Total Serum Cholesterol Visit 1 (mg/dl)	.85	.07
BMI at Visit 3 (Kg/m²)	.23	.65
Sex (0 = women, 1 = men)	−3.02	4.42

Dependent Variable = Change in Total Serum Cholesterol (Visit 3 – Visit 1)

Independent Variable	Coefficient	S.E. Coefficient
Group (0 = Control, 1 = Intervention)	−9.00	4.26
Total Serum Cholesterol Visit 1 (mg/dl)	−.16	.07
Change in BMI (Visit 3 – Visit 1) (Kg/m²)	9.05	3.67
Sex (0 = women, 1 = men)	−2.18	4.14

From a public health perspective, perhaps the most important finding common among these studies is that the combined decreased fat and increased carbohydrate approach is practical, feasible, nutritious, and efficacious in lowering blood cholesterol among normolipidemic as well as hyperlipidemic individuals.

The study reported here measured self-imposed changes in dietary behavior and lipid response resulting from daily inclusion of instant oatmeal in the otherwise regular diet of hyperlipidemic men and women. Some of the earliest studies exploring the simple addition of fiber to a usual diet did not report specific dietary changes or displacement invoked when oats were substituted for other possibly high fat foods.[10,20,21,23] A more recent study incorporated large amounts of oats, constituting a major share of the caloric intakes thus limiting the participants capacity for other foods.[24] Documentation of the dietary changes associated with oat intervention serves to more accurately attribute blood cholesterol response to the relevant dietary factors. This study represents an initial attempt to document these changes. Results of nutrient analyses suggest that the recommendation to incorporate oats on a daily basis led to self-initiated changes in dietary fat intake, as well as increased intake of several essential nutrients. These results also illustrate the feasibility of eating moderate amounts of oats daily, without weight gain or side effects reported when greater amounts are consumed.[24] The differences between observed versus predicted blood cholesterol values in the intervention group suggest that the minor changes in dietary lipid intake alone did not completely explain the observed reductions. The instant oats, presumably by increasing soluble fiber intake, and the slight weight loss appear to have contributed to the overall serum cholesterol response. The relatively high drop out rate prior to baseline may have contributed to the imbalance in mean baseline blood cholesterol levels between groups that, although not statistically significant, may have somewhat confounded these results. Intensified intervention aimed at further decrease in intake of total fat, saturated fatty acids and dietary cholesterol, increased carbohydrate and reduction of excess body weight, would predictably further reduce serum cholesterol levels among these individuals.

More research is needed to clarify dose responses and evaluate long term effects of increased soluble fiber intake among hyperlipidemic and normolipidemic individuals. Potential differences in response to such regimens requires further exploration. ☐

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Calendar for APHA 1991 Policy Development Process

The following schedule has been established for the development of APHA public policy resolutions and position papers in 1991. Full details of the Association's procedures for this activity can be obtained from:

AMERICAN PUBLIC HEALTH ASSOCATION, Attention: Richard Carson, 1015 Fifteenth Street, NW, Washington, DC 20005; (202) 789-5623

March 22 All proposed resolutions and position papers are due at APHA headquarters. They should be sent to the attention of the Joint Policy Committee. Proposals submitted via fax must be followed by hard copy within two days.

May 6–7 The Joint Policy Committee (JPC) meets in Washington to make an initial group assessment on each proposed policy statement. (Between March 22 and May 6, members of four reference committees will review each proposed policy statement. In addition, appropriate section chairpersons, SPIGs, and selected individuals are asked to review related proposed policy statements.)

May 24 All proposed statements are returned to authors with an inital assessment by the JPC.

June 28 Revised policy statements, to be considered by the 1991 Governing Council, must be back at APHA headquarters.

September Proposed policy statements are mailed to all APHA members in *The Nations's Health.* Copies are mailed to members of the Governing Council.

November 10 Annual Meeting—"Late-Breakers"—Submission deadline 6:00 pm (Sunday), for "late-breaking events." The chairpersons of the public hearings will be instructed that only those policy statements which address issues that have arisen between March 22 and the Annual Meeting will be considered as late-breaking events.

November 11 Annual Meeting—Public Hearings are conducted by the Reference Committees.

November 12 Annual Meeting—Joint Policy Committee meets in executive session to develop final recommendations for presentation of proposed resolutions and position papers to the Governing Council on Wednesday.

November 13 Annual Meeting—Governing Council votes on policy.

Validation of a Surveillance Case Definition of Carpal Tunnel Syndrome

Jeffrey N. Katz, MD, MS, Martin G. Larson, ScD, Anne H. Fossel, and Matthew H. Liang, MD, MPH

ABSTRACT

The National Institute for Occupational Safety and Health (NIOSH) has proposed a surveillance case definition for work-related carpal tunnel syndrome (CTS). The case definition requires the presence of median nerve symptoms; one or more occupational risk factors; and objective evidence of CTS including one of three physical examination findings or nerve conduction tests diagnostic of CTS. We evaluated the performance of the NIOSH case definition, restricting our analysis to cases in which physical examination findings served as the objective criterion. Nerve conduction studies were used as the gold standard. Seventy-eight workers were studied; 38 percent had CTS. The NIOSH case definition had sensitivity of 0.67 (95% CI = 0.57, 0.77), specificity of 0.58 (95% CI = 0.47, 0.69), and positive and negative predictive values of 0.50 (95% CI = 0.39, 0.61) and 0.74 (95% CI = 0.64, 0.84), respectively. Overall 38 percent of subjects were classified incorrectly. In a sample with a prevalence of 15 percent, as might be encountered in high risk workplaces, the positive predictive value would be 0.22. In conclusion, when physical examination findings serve as the objective criterion the performance of the case definition is modest reflecting the limited diagnostic value of its component tests and indicating that effective screening for CTS awaits improved diagnostic techniques. (*Am J Public Health* 1991;81:189–193)

Introduction

Carpal tunnel syndrome is a major problem in occupational health, particularly in occupations requiring highly repetitive and/or forceful hand motions.[1] Up to 15 percent of workers in the highest risk industries are affected annually,[2] 100 times more than expected in an age- and sex-adjusted population.[3] Costs per worker may exceed $15,000, including medical and indemnity expenses.[2,4]

Accurate and efficient diagnosis of carpal tunnel syndrome is important for research and clinical practice. Nerve conduction testing is generally regarded as the gold standard for the diagnosis of carpal tunnel syndrome.[5] The sensitivity of nerve conduction tests has been estimated at over 80 percent when compared with a clinical diagnosis of carpal tunnel syndrome in a community based study[6] and over 90 percent when compared with relief following surgery in 292 patients undergoing carpal tunnel release.[7] Electrophysiologic tests require 30 to 60 minutes, expensive equipment and experienced operators; thus, they may be inappropriate for many occupational surveillance efforts. Thermography[8] and vibrometry[9] are noninvasive but costly and have not been evaluated rigorously.

The clinical history and physical examination are inexpensive and simple to administer but are of limited value in the diagnosis of carpal tunnel syndrome. For example, nocturnal pain has a specificity of 0.28 and diminished two-point discrimination has a specificity of 0.32.[10] The Tinel and Phalen signs have sensitivities of 25–75 percent and specificities of 47–90 percent.[10–14] These data suggest that screening instruments comprised solely of historical and physical findings may not accurately identify workers with carpal tunnel syndrome.

The National Institute for Occupational Safety and Health (NIOSH) recently approved a surveillance case definition for work-related carpal tunnel syndrome[15] (see Figure 1). The NIOSH surveillance case definition of carpal tunnel syndrome requires that workers satisfy three criteria: symptoms of median nerve involvement; a history of occupational risk factors such as repetitive or forceful hand tasks or use of vibrating tools; and either the presence of physical examination findings—including the Tinel or Phalen signs or decreased pinprick sensation in the median nerve distribution of the hand—or diagnostic nerve conduction studies. To date the validity of NIOSH case definition has not been tested. The performance of the case definition is of particular interest when physical examination findings are used as the objective evidence required to fulfill criterion B (Figure 1). The purpose of this study is to test the NIOSH case definition in a sample of symptomatic workers. Physical examination findings serve as the sole objective evidence of disease (criterion B) in this

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Editor's Note: See also related editorial p 161 this issue.

FIGURE 1—NIOSH Surveillance Case Definition of Work-Related Carpal Tunnel Syndrome*

Criteria A, B, and C must be met:

A. Symptoms suggestive of carpal tunnel syndrome: paresthesia, hypoesthesia, pain or numbness affecting at least part of the median nerve distribution of the hand.

B. Objective findings consistent with carpal tunnel syndrome:

Either, (1) One or more of the following physical findings: Tinel sign, Phalen sign, or decreased or absent sensation to pin prick in the median nerve distribution of the hand.

or, (2) Electrodiagnostic findings of median nerve dysfunction across the carpal tunnel.

C. Evidence of work relatedness: One or more of the following: Frequent, repetitive or forceful hand work on affected side; sustained awkward hand position; use of vibrating tools; prolonged pressure over wrist or base of palm; temporal relationship of symptoms to work or association with carpal tunnel syndrome noted in co-workers.

*adapted from reference 15

study and nerve conduction tests are used as the gold standard for the diagnosis of CTS.

Methods

An evaluation of clinical tests for carpal tunnel syndrome was carried out from January through June 1988. Details of the study have been reported.[10] Briefly, consecutive patients over 18 years of age with pain or paresthesia in the upper extremity who were referred to the Brigham and Women's Hospital Neurophysiology Laboratory were studied. A subset of this sample who were working or disabled as a result of their upper extremity condition are the subject of this report. Prior to neurophysiologic testing patients were evaluated by one of four examiners (a rheumatologist and three research assistants) who administered a questionnaire and performed a standardized physical examination. Examiners were blind to the results of nerve conduction tests.

Clinical data included demographic information, co-morbid conditions, occupation, and self-report of whether patients were exposed in their work to repetitive hand motion, vibration, or forceful wrist flexion or extension. The subjects also completed a hand pain diagram[16] which depicts dorsal and palmar views of both hands. Patients were asked to shade in areas corresponding to the location of their symptoms. Diagrams were rated blindly as "classic carpal tunnel syndrome," "probable," "possible," or "unlikely."

Moving two point discrimination[17] was performed with electrocardiogram calipers with tips set at four millimeters apart. The Tinel sign was performed by dropping the square end of a reflex hammer on the distal wrist crease. Pain or paresthesia in at least one of the first three digits constituted a positive response.[18] The Phalen sign was performed with the dorsal aspects of both flexed wrists in apposition for 60 seconds, and was considered positive if pain or paresthesia occurred in one of the first three digits.[19]

The presence or absence of CTS was established by the neurophysiologists with nerve conduction testing. The core protocol consisted of bilateral ulnar and median motor and sensory nerve conduction tests and electromyography of the abductor pollicus brevis. (Some subjects refused bilateral testing and/or electromyography.) Additional tests such as palm-to-wrist latencies[6] were performed according to the clinical circumstances at the discretion of the neurophysiologists. The neurophysiologists were blind to the results of physical examinations performed by the study investigators. The diagnosis of carpal tunnel syndrome required at least one of the following: median motor latency greater than 4.0 m/sec; sensory latency greater than 3.7 m/sec; and/or sensory velocity less than 50 m/sec. Ulnar nerve conduction and electromyography were used to exclude polyneuropathy, radiculopathy, and other diagnoses.

Criterion A of the NIOSH case definition (Figure 1) corresponded to a possible, probable, or classic rating on the hand pain diagram.[16] Criterion B corresponded to a positive Tinel or Phalen sign or diminished two point discrimination. The nerve conduction criterion was not used because our goal was to evaluate the performance of the case definition specifically when physical examination data are used as the objective criterion. Criterion C was satisfied if patients reported exposure on their jobs either to vibration, repetitive pinching, grasping, or wrist flexion or extension.

The sensitivity, specificity, odds ratio, positive predictive value (proportion with a positive test result who had carpal tunnel syndrome) and negative predictive value (proportion with a negative test result who did not have carpal tunnel syndrome) were determined for each of the diagnostic tests and for the NIOSH case definition.[20] Statistical analyses were performed with the chi-squared statistic using the SAS statistical package[21] on an International Business Machines P/S 2 Model 60 computer. Confidence intervals for sensitivity and specificity estimates were performed assuming a binomial distribution[22] and confidence intervals for predictive values were calculated with an iterative proportional fitting algorithm assuming a hypergeometric distribution.

Results

Seventy-eight symptomatic subjects were studied. Sixty-six were working at the time of evaluation and 12 were temporarily disabled as a result of their upper extremity problems. Patient characteristics are presented in Table 1. The mean age was 43.4 years. Sixty-three percent of subjects were female and 77 percent were White. Ten percent of patients had diabetes mellitus, 6 percent had thyroid disorders, and 4 percent had rheumatoid arthritis. These conditions were well controlled at the time of evaluation. Ten percent (eight patients) had prior carpal tunnel release surgery. Four of these eight patients were found to have carpal tunnel syndrome; in all four the previously operated hand was involved. Sixty-nine percent of subjects reported that their work involved repetitive hand motion, vibration, or forceful wrist flexion or extension. Thirty-eight percent of subjects had carpal tunnel syndrome documented by nerve conduction; diagnoses in the other patients are listed in Table 1.

Table 2 depicts diagnostic performance features of the individual components of the NIOSH case definition and of the case definition itself. In univariate analyses the presence of symptoms in at least part of the median nerve distribution of the hand was highly sensitive for carpal tunnel syndrome (0.93 [95% CI: 0.87, 0.99]) but non-specific (0.25 [95% CI: 0.15, 0.35]). The presence of occupational risk factors was also sensitive (0.83 [95% CI: 0.75, 0.91]) but nonspecific (0.40 [95% CI:

TABLE 1—Baseline Clinical and Demographic Features (N = 78)

Feature	Number of Subjects	(%)
Age (years)		
Less than 40	28	(35.9)
40–54	36	(46.2)
Greater than 54	14	(17.9)
Female	49	(62.8)
Duration of symptoms*		
Less than 2 months	18	(24.0)
2–12 months	31	(41.3)
Greater than 12 months	26	(34.7)
Prior carpal tunnel release	8	(10.3)
Occupation		
Professional (e.g. lawyer, doctor, business person)	15	(19.2)
Clerical/data processing	16	(20.5)
Manual handling	24	(30.8)
Manager (e.g. of store)	15	(19.2)
Artisan	8	(10.3)
Electrophysiological diagnosis		
Normal	22	(28.2)
Carpal tunnel syndrome	30	(38.5)
Ulnar neuropathy	10	(12.8)
Cervical radiculopathy	9	(11.5)
Other†	7	(9.0)
Total	78	100

*Data missing on three patients.
†Other diagnoses include brachial plexus lesions, polyneuropathy, other entrapments.

0.29, 0.51]). The Phalen sign was similarly sensitive (0.73 [95% CI: 0.63, 0.83]) but non-specific (0.36 [95% CI: 0.25, 0.47]), while the Tinel sign was less sensitive (0.62 [95% CI: 0.51, 0.73]) but more specific (0.66 [95% CI: 0.56, 0.77]). Two point discrimination was the least sensitive (0.23 [95% CI: 0.14, 0.32]) and most specific (0.82 [95% CI: 0.74, 0.91]) test for carpal tunnel syndrome.

The individual criteria were combined according to the NIOSH surveillance case definition and compared to actual diagnoses confirmed by nerve conduction tests. The case definition had sensitivity of 0.67 (95% CI: 0.57, 0.77), specificity of 0.58 (95% CI: 0.47, 0.69), positive predictive value of 0.50 (95% CI: 0.39, 0.61) and negative predictive value of 0.74 (95% CI: 0.64, 0.84). Overall, 48 of 78 (62 percent) subjects were classified correctly by the surveillance case definition. Bayes' Theorem[20] was used to calculate the predictive values in a population with prevalence of 0.15, as might be found in high-risk industries. In such a population the positive predictive value of the case definition would be 0.22 and the negative predictive value would be 0.91.

Discussion

Carpal tunnel syndrome has been associated with a variety of occupations including meat packing,[2] aircraft and bearing manufacturing,[1,23] sewing,[24] grocery checking,[25] and many others. Epidemiologic studies relating carpal tunnel syndrome to specific occupations have been limited by the lack of uniform, valid criteria for case ascertainment. The diagnostic gold standard, nerve conduction testing, is not suitable for many large surveillance efforts. Furthermore, simple clinical tests are of limited diagnostic value.[10]

The proposed NIOSH surveillance case definition is an important step toward standardization of surveillance. The present study is the first validation of the case definition against verified cases of carpal tunnel syndrome. This study suggests that when physical examination findings serve as the objective criterion the case definition has important limitations and must be used carefully. In our sample of workers with upper extremity complaints the positive predictive value of the case definition was 0.50 (95% CI: 0.39, 0.61) and the negative predictive value was 0.74 (95% CI: 0.64, 0.84). These results indicate that half of workers satisfying the case definition did not have carpal tunnel syndrome while a fourth of subjects not satisfying the case definition did. Overall, 38 percent of subjects were classified incorrectly.

It is critical to note that predictive values vary with the prevalence of disease. Carpal tunnel syndrome was more prevalent in our sample (0.38) than in other reported groups of symptomatic workers.[26,27] In a hypothetical sample of workers with a prevalence of CTS of 15 percent the positive predictive value of the NIOSH case definition would be just 0.22.

In evaluating the usefulness of the case definition it is important to distinguish between epidemiological surveillance, which provides information about disease prevalence in target populations, and screening, which identifies individuals at risk of disease.[28] The NIOSH case definition is a surveillance instrument intended for "use by state health departments to facilitate standardized counting of cases"; it is not intended for clinical use.[15] In surveillance programs designed solely to identify high-risk workplaces, simplicity and low cost are paramount. False negative and false positive results may compromise estimates of risk in these settings but do not adversely affect individual workers.[28] Our data suggest that the NIOSH case definition would be suitable for occupational surveillance as it is simple, inexpensive and accurate in 62 percent of subjects in our sample.

In contrast, inaccurate results exact higher costs when tests are used to identify possible cases for further testing and treatment. Here the cost of false negative test results is withholding treatment from workers who might benefit. The costs of false positives include worker anxiety, work absenteeism,[29] and the expense of disproving the screening diagnosis (e.g. $200–500 for a physician visit and nerve conduction tests). The modest sensitivity (0.67) and specificity (0.58) of the NIOSH case definition suggest that it should be used carefully if at all in screening for affected individuals or in clinical practice.

Other combinations of tests performed in parallel or in series would produce different trade-offs between sensitivity and specificity.[30] For example, we have demonstrated that the combination of a probable or classic hand diagram *or* a positive Tinel sign has sensitivity of 0.82 (95% CI: 0.75, 0.89) and specificity of 0.50 (95% CI: 0.41, 0.59), while a probable or classic diagram *and* positive Tinel sign has sensitivity of 0.39 (95% CI: 0.30, 0.48) and specificity 0.89 (95% CI: 0.83, 0.95).[10] However, no individual test or combination of tests offers sensitivity and specificity over 0.70 (Table 2) reflecting inherent limits in the diagnostic value of clinical tests for carpal tunnel syndrome.[10]

This study has several limitations. Subjects were referred to a hospital labo-

TABLE 2—Diagnostic Performance Characteristics of the NIOSH Case Definition and Its Component Parts

						In Sample with 15% Prevalence	
	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Odds Ratio (95% CI)	Positive Predictive Value	Negative Predictive Value
Median n. symptoms	0.93	0.25	0.44	0.86	4.67 (0.97, 22.57)	0.18	0.96
Occupational risk factors*	0.83	0.40	0.46	0.78	3.28 (1.07, 10.06)	0.21	0.93
Tinel sign	0.62	0.66	0.53	0.74	3.17 (1.21, 8.30)	0.24	0.91
Phalen sign	0.73	0.36	0.40	0.70	1.50 (0.5, 4.3)	0.17	0.88
Median sensory loss†	0.23	0.82	0.47	0.62	1.45 (0.46, 4.52)	0.19	0.86
Case definition	0.67	0.58	0.50	0.74	2.80 (1.08, 7.25)	0.22	0.91

*Exposure to repetitive pinching, grasphing, wrist flexion or vibration.
†Moving two point discrimination of 4 mm.

ratory for neurophysiologic evaluation. Some may have had particularly severe carpal tunnel syndrome, raising the sensitivity of diagnostic maneuvers, or atypical syndromes lowering specificity.[31] While all subjects were working or disabled it is not clear what proportion of cases were unequivocally work-associated or whether the case definition would perform differently in such cases. Also, we limited our analysis to cases in which criterion B was satisfied by physical examination rather than nerve conduction findings. Thus our analysis likely underestimates the specificity of the case definition. In addition, while nerve conduction tests are the best gold standard available, false negatives are well documented[7] and the false positive rate is not precisely defined, raising the possibility of misclassification error. Furthermore, occupational risk was estimated on the basis of self-reported exposure to vibration and repetitive finger and wrist flexion which is less accurate than detailed ergonomic analyses of job requirements. Finally, carpal tunnel syndrome is just one of a variety of occupation-associated upper extremity disorders. Symptomatic workers who do not have carpal tunnel syndrome may have other occupation-related cumulative trauma disorders[26] and might benefit from job modification and treatment.

We conclude that when the physical examination is used as the objective evidence to satisfy criterion B, the NIOSH case definition yields a significant number of false positive and false negative results. False positives will be especially common in groups of workers with a low prevalence of carpal tunnel syndrome. While the case definition appears to be suitable for epidemiologic surveillance, these inaccuracies make the case definition suboptimal for use in screening individual workers. The modest performance of the case definition reflects limitations inherent in its component tests, suggesting that accurate non-invasive testing for occupational carpal tunnel syndrome awaits the development and validation of better diagnostic technologies. ☐

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Free Information Packet on Women and AIDS

In response to the growing need for information on women and HIV (human immunodeficiency virus)/AIDS (acquired immunodeficiency syndrome), the National AIDS Information Clearinghouse has increased its efforts to collect and disseminate information for and about women with HIV. Results of this effort led to the development of a new information packet which provides resources offered by the Clearinghouse. The Women and AIDS Information Packet developed by the Clearinghouse contains:

- A fact sheet describing Clearinghouse resources and services for women: e.g. to locate funding opportunities for women's programs or to find child care and housing assistance programs.
- Customized, topical searches of Clearinghouse databases: a selected list of educational materials for professionals concerned about HIV and AIDS and women; a list of materials for use in HIV education activities with women; a list of organizations offering services for women.
- A publications list of HIV and AIDS eductional materials offered by the Clearinghouse including brochures, posters, and videotapes.
- *A Selected Guide to Information about Women and HIV/AIDS* for use by health professionals, graduate or undergraduate students, or other interested persons. The guide lists books, indexes, online information sources, newsletters, journals, directories, and organizations that provide information about women and AIDS.

To obtain the free information packet, contact National AIDS Information Clearinghouse, P.O. Box 6003, Rockville, MD 20850; Toll-free: 1-800-458-5231, TTY/TDD: 1-800-243-7012, FAX: 1-301-738-6616; International line: 1-301-217-0023; Hours: 9am–7pm, EST, M–F.

Public Health Briefs

Behavioral, Health and Psychosocial Factors and Risk for HIV Infection among Sexually Active Homosexual Men: The Multicenter AIDS Cohort Study

Lili Penkower, PhD, Mary Amanda Dew, PhD, Lawrence Kingsley, PhD, James T. Becker, PhD, Paul Satz, PhD, Frederick W. Schaerf, MD, PhD, and Kathleen Sheridan, JD, PhD

ABSTRACT

We examined whether 644 homosexual men who engaged in receptive anal intercourse were at particularly elevated risk for seroconversion if they also possessed specific behavioral, health or psychosocial vulnerability characteristics. Of 11 potential factors examined, heavy drinking, moderate to heavy drug use, and younger age were significantly related to seroconversion. These variables were also associated with an increased number of sexual partners, anonymous sex, and failure to use condoms. (*Am J Public Health* 1991; 81:194–196)

Introduction

Host vulnerability to illness is a complex process involving biologic, psychologic and social factors.[1-4] With regard to acquired immunodeficiency syndrome (AIDS), the etiologic agent, human immunodeficiency virus (HIV), is known and two behavioral factors, intravenous drug use and high-risk sexual behavior, transmit the virus.[5] Cofactors, increasing the likelihood that HIV-exposed individuals will become infected, have been suggested.[6-8] They include pre-existing health and behavioral factors (e.g., smoking, recreational drug use, alcohol consumption) and psychosocial factors (e.g., depression, lack of social support). We examined the impact of these variables on seroconversion risk in homosexual men engaged in high-risk sexual activity.

Methods

A sample of 1,045 bisexual and homosexual men was drawn from the total cohort of men enrolled in the Multicenter AIDS Cohort Study (MACS) between 1984–87. Participants in this four-site, longitudinal study were examined semi-annually (see Kaslow, *et al*,[9] for further cohort description). Our sample included all 209 men who: became HIV seropositive (HIV+) between 1984–87; and had tested seronegative (HIV−) six months before. Data from their last HIV− visit were utilized as "baseline" data; data from their first HIV+ visit were designated "follow-up" data. A comparison sample of 836 men, who were HIV− throughout 1984–87 and represented the four sites in the same proportion as the HIV+ sample, was randomly selected. For each HIV− man, we randomly selected two consecutive waves of interviews (six months apart) which we designated as the "baseline" and "follow-up" visits.

High-risk sexual behavior was defined as receptive anal intercourse in the prior six months.[10-12] At each interview, additional variables in the previous six months were assessed: number of sexual partners with whom respondents had receptive anal intercourse; number of anonymous partners; number of partners with whom respondents had used condoms during anal intercourse; and number of partners who themselves used condoms during anal intercourse with respondents.

Three categories of vulnerability factors, potentially affecting seroconversion risk, were measured at baseline (see first two columns of Table 1 for descriptive statistics). Absolute numbers of CD4+ cells were counted by direct immunofluorescence with use of monoclonal antibodies with an EPICS-C flow cytometer.[13] All variables were available for all men.

Results

At baseline, high-risk sexual behavior was reported by 87.0 percent of the 209

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TABLE 1—Relationship of Pre-existing Vulnerability and Subsequent Serostatus among High-risk Sexually Active Men (N = 644)

	Seropositive (N = 181)		Seronegative (N = 463)		Regression[h]	
Vulnerability Factor	n	%	n	%	Odds Ratio	95% Confidence Interval
Behavior						
Alcohol consumption (% heavy)[a]	62	34.3	86	18.6	1.39	1.12, 1.72
Smoking (% yes)	78	43.1	143	30.9	1.22	.99, 1.50
Recreation drug use (% moderate-heavy)[b]	92	50.8	166	35.9	1.25	1.03, 1.51
Immune Status and Health History						
CD4+ Cells (% ≤ 700)[c]	44	25.9	102	23.4	1.16	.93, 1.45
Chronic physical illness (% yes)[d]	8	4.4	14	3.1	1.17	.73, 1.97
Psychosocial and Background						
Depression (% highly symptomatic)[e]	35	19.7	79	17.1	.89	.68, 1.16
Self-esteem (% low)[f]	13	7.3	22	4.8	1.32	.88, 1.99
Confidant (% none)[g]	10	5.6	15	3.2	1.30	.83, 2.03
Age (% ≤ 35 years)	122	67.4	274	59.2	1.25	1.02, 1.52
Education (% ≤ high school)	23	12.8	41	8.9	1.13	.83, 1.53
Race (% non-White)	11	6.1	13	2.8	1.20	.73, 1.97

[a] Cahalan quantity-frequency index.[14]

[b] recreational drugs include at least weekly use of marijuana, cocaine, nitrite inhalants, barbiturates, or amphetamines.

[c] fell in lowest quartile of sample distribution.

[d] chronic illnesses include cancer, diabetes, kidney disease, lupus, vasculitis, rheumatoid arthritis, ankylosing spondylitis, Graves disease, Reiter's syndrome, or myasthenia gravis.

[e] scores of 16+ on the Center for Epidemiologic Studies Depression Scale (CES-D).[15]

[f] one item from Rosenberg Scale.[16]

[g] Brown & Harris[17]

[h] Goodness of Fit χ^2 (1) = 168, p = .011.

respondents who had seroconverted by follow-up, compared to 56.3 percent of the 836 seronegative men. The strong association between anal receptive sexual practices and seroconversion led us to focus on the 644 men who had engaged in high-risk sexual behavior at baseline.

After controlling for all other vulnerability factors, baseline heavy alcohol consumption, moderate to heavy drug use, younger age and, to a lesser extent, smoking were associated with seroconversion (Table 1).

We found no evidence that heavy drinkers, moderate to heavy drug users or younger men had fewer absolute numbers of CD4+ cells at baseline. Regarding the high-risk behaviors at baseline, however, heavy drinkers were indeed more likely to have engaged in receptive anal intercourse with more partners, had more anonymous sex, and were less likely to have either used condoms themselves or had partners who used condoms during anal intercourse. Similarly, moderate to heavy drug users reported more sexual partners and more anonymous sex. Younger men were more likely to have engaged in high-risk sex with more partners (data not shown; available on request to authors).

Discussion

The MACS' longitudinal design provided an unusual opportunity to examine data on behavioral, health, and psychosocial factors assessed prior to evidence of HIV seroconversion. Among men already at high risk for HIV infection, heavy alcohol consumption, moderate to heavy drug use and younger age further increased their likelihood of seroconversion by the follow-up visit.

Of these three factors, heavy alcohol consumption was most strongly associated with subsequent seroconversion. This finding is consistent with other evidence that alcoholics are at greater risk for infections of many types, and also have elevated morbidity and mortality rates.[18,19] Molgaard, *et al*,[20] have suggested that the importance of alcohol may derive from an association with impaired immunity and/or its behavioral effect on risky sexual practices. Our data suggest that its link to sexual practices may be of relatively greater concern. Thus, consistent with Kaslow, *et al*,[21] we found that CD4+ cells (albeit a limited measure of general immune function) bore little relation to heavy drinking. However, among men who all reported engaging in receptive anal intercourse heavy drinkers further elevated their risk of HIV exposure by engaging in sex with more partners, having more anonymous sex and by failing to employ condoms during high-risk sex.

Results for drug use and younger age were similar to alcohol. While drug users did not have lower CD4+ cell counts, they were more likely to engage in anonymous sex and had more sexual partners. It is noteworthy that, in comparison to all other drugs we examined, nitrite inhalant (popper) use was most strongly associated with seropositivity risk (odds = 11.83, 95% CI = 1.34, 3.04). Moss, *et al*,[22] recently reported a similar association. While no differences were observed in CD4+ cells among younger men, they were more likely to engage in high-risk sex with more partners.

We recognize several limitations in our study. First, a restricted number of potential risk factors were studied; many other factors (e.g., additional immune parameters, anxiety, nutrition, specific types of social support) remain to be investigated. Second, two of the psychosocial variables, self-esteem and social support, were each determined by a single question, and may have been inadequate measures of these constructs.

Nevertheless, our results suggest that efforts at controlling the spread of HIV infection may be improved by identifying individuals in high-risk groups whose other characteristics further heighten their already elevated likelihood of becoming infected. From a public health standpoint, it is imperative that the risks associated with substance abuse be recognized and that programs to educate and treat these addictions be made available and accessible. This study demonstrates empirically that individuals who engage in risky sexual practices and who are also heavy drinkers and/or drug users are at increased risk of becoming infected with HIV.

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Responsible Alcohol Service: A Study of Server, Manager, and Environmental Impact

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ABSTRACT

A responsible alcohol-service training program was evaluated for its impact on changing beliefs, knowledge, and behavior in 97 servers and 43 managers and on changing establishment policies that encourage safer drinking environments. The training program had a significant impact on changing the beliefs and knowledge of both servers and managers. Observation 4 to 6 weeks after training showed no effects on server behavior, but there was a tendency toward more establishment policies compared with controls. (*Am J Public Health* 1991;81:197–199)

Introduction

Deaths and injuries associated with driving while under the influence of alcohol are important public health problems.[1] In 1988, half of all traffic fatalities were alcohol related.[2] Making drinking establishments the site of interventions to reduce alcohol-related accidents has increased in popularity. Establishments may be held legally responsible for the behavior of customers who leave under the influence of alcohol[3–5]; and a growing number of states and cities require that all servers of alcohol receive training in responsible alcohol service.

Evaluations of several alcohol-service training programs suggest that they can have some impact on the drinking behavior of patrons.[6–9] While some programs focus primarily on teaching servers how to intervene with intoxicated customers, others seek to be more comprehensive by focusing on servers, managers, and environmental features of the establishment.[10–11] The Responsible Beverage Service (RBS) Training Program studied in the current research focused on all three of these elements.[12]

Methods

A newly expanded Utah law required that servers of alcohol and managers of establishments that serve alcohol participate in a state-certified training program every 3 years. Ninety-seven servers from 19 restaurants and bars and 43 managers from 21 establishments (26 different establishments in all) in Park City, Utah, attended a 1-day training session. Fourteen establishments matched on type and size were randomly selected from the remaining city establishments to serve as controls. They had not been exposed to this training, which was new in this community.

Servers and managers attended separate programs that taught the physical and behavioral effects of alcohol and strategies for providing more responsible alcohol service using a combination of lecture, role play, and feedback. Managers also received instruction on developing company policies to change the drinking environment. Participants completed pre- and post-training questionnaires measuring beliefs and knowledge about responsible alcohol-service practices. Further details are available on request.

One month following the RBS training, trained pairs of observers (each consisting of a man and a woman) with a mean age of 31 assessed server behavior and current policies in treatment and control establishments. The observers were blind to the treatment conditions, and the servers were unaware that they were being observed.

Observers first recorded ID-checking practices for the first three patrons both observers agreed looked 30 years old or younger (a practice taught to servers in the training) and environmental signs of responsible alcohol service in one establishment (described later). At a second establishment, one member of the pair drank three alcoholic beverages and tried to order a fourth in 1 hour. This amount ensured that the drinking observer was well on the way to being legally drunk (0.08 percent blood alcohol level in Utah). The consumption was such that if they followed their training, servers should have been able to interpret this drinking behavior as appropriate for intervention. The nondrinking observer recorded servers' interventions.

Results

T-tests on the pre- and post-test measures indicated that servers and managers

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TABLE 1—Mean Number of Interventions by Servers in Treatment and Control Establishments

Type of Intervention	Treatment Servers (n = 22)	Control Servers (n = 19)
Communicated that server was aware of customer's drinking behavior	0.14	0.32
Slowed the delivery of drinks to the table	0.18	0.26
Suggested customer order a nonalcoholic drink or food	0.23	0.37
Offered to find transportation for an intoxicated customer	0.00	0.00
Explained that house policy does not allow the server to serve another alcoholic drink to customer	0.18	0.16
Verified that the nondrinking customer would do the driving	0.00	0.00
Refused to serve customer another alcoholic drink	0.23	0.16
Notified management if intoxicated customer became problematic	0.00	0.00
Mean of all interventions	0.95	1.26

Note: Data are based on observations by a nondrinking observer of server interventions with the drinking observation partner.

TABLE 2—Percent of Treatment and Control Establishments Showing Responsible Alcohol-Service Practices

Type of Practice Observed	Treatment Establishment (n = 13)	Control Establishment (n = 11)
Did not serve pitchers of beer or mixed drinks	46%	73%
Did not serve doubles	85%	82%
Did not offer happy hours	77%	82%
Had signs advertising low- or non-alcoholic drinks	38%	18%
Had transportation information	15%	9%
Had no employee drinking on the job	92%	73%
Mean of all policies	3.54	3.36

increased their knowledge and showed improvement in their beliefs that customers would respond favorably to responsible alcohol service and policies $p < .001$, all measures. The training was less successful in teaching servers and managers new strategies for intervening with customers, as reported in open-ended questions. (Data are available on request.)

Table 1 reports data on observations of interventions by servers. No differences were observed between treatment (n = 22) and control (n = 19) servers on any intervention nor on a summed average of eight possible interventions.

Observations of establishment practices were conducted in 13 of the 21 establishments with trained managers and 11 of the 14 control establishments (Table 2). Treatment establishments were more likely to have signs advertising low-alcohol or nonalcoholic drinks and to show less evidence of employees drinking on the job than control establishments, but they were also more likely to serve pitchers of beer or mixed drinks. These findings are tentative because of the small sample sizes. In addition, checking IDs of patrons under 30 was observed at only 14 treatment establishments (9 percent) and 14 control establishments (18 percent), a nonsignificant difference.

Discussion

Questionnaire data indicated that the training program had a positive impact on improving knowledge and beliefs. Observational data collected 4 to 6 weeks after training about the effectiveness of the training program were inconclusive given the small sample sizes and design limitations of the study. Diffusion of training from treatment to control conditions, while unlikely, cannot be completely ruled out; neither can preexisting differences between conditions, although matching on establishment type and size should have increased the comparability between conditions.

Overall, the observations seemed to indicate relatively little impact of the training program on server behavior but did show a tendency for the treatment establishments to engage in more responsible practices than control establishments. Although tentative, these findings suggest that other programs may want to incorporate training on policy issues in addition to server-intervention training.

Responsible alcohol-service programs should consider offering programs in the working environments of managers and servers to better convince staff of the benefits of responsible alcohol-service practices. On-site, tailored feedback on appropriate practices might provide more potent training and a better diagnosis of establishment features that create barriers to responsible alcohol service.[9]

Furthermore, one-on-one training with managers, including follow-up support, may be needed to encourage establishments to develop policies and to help them overcome obstacles to implementation. In the current study, some managers may not have had the authority or support to implement new policies. Previous research suggests that before responsible alcohol-service practices can become fully institutionalized, support at all levels must be obtained.[5,9]

State and local regulations also can do more to encourage responsible alcohol-service practices. States that mandate training could require documentation of changes in policy and server behavior to encourage implementation of responsible practices. Regulations banning practices such as happy hours and serving doubles should be combined with educational strategies to convince establishments that practicing responsible alcohol service will not put them at an unfair competitive advantage or adversely affect customer volume and tips. Future research on the role drinking establishments can play in reducing alcohol-related problems should continue to focus on comprehensive strategies including government regulation, establishment policies, and server behavior. □

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Increased Risk of Ectopic Pregnancy with Maternal Cigarette Smoking

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ABSTRACT

As part of a case-control study of ectopic pregnancy, we evaluated the potential etiologic role of cigarette smoking. Maternal cigarette smoking at the time of conception was associated with an increased risk of ectopic pregnancy with a dose-response relationship (adjusted odds ratios: 1.30 to 2.49). On the other hand, partner's smoking was not associated with ectopic pregnancy. The study provides a supplementary argument towards a causal effect of smoking in the development of ectopic pregnancy. (*Am J Public Health* 1991;81:199–201)

Introduction

During the past two decades, the incidence of ectopic pregnancy has doubled or tripled in many parts of the world.[1] It currently constitutes 1.2 to 1.4 percent of all reported pregnancies[1], and remains the leading cause of maternal death during the first trimester of pregnancy in industrial countries.[2] The main identified risk factors are pelvic inflammatory disease (PID) and sexually transmitted diseases (STDs), previous ectopic pregnancies, pelvic surgery, previous use of intrauterine device (IUD), and oral contraceptives and IUD use at the time of conception.[1] Several studies have shown a positive association with cigarette smoking.[3–8] In most of them, smoking was not the primary hypothesis and the precise quantity of cigarette smoked was not investigated. Furthermore, some important confounding factors (e.g., STDs) were not taken into account.

As part of a case-control study of ectopic pregnancy, we further investigated the potential etiologic relationship between cigarette smoking, correcting for the above deficiencies wherever possible.

Methods

A case-control study was conducted during 1988 in seven large maternity hospitals in the Paris area (France). The cases were women ages 15–44 years, whose diagnosis had been confirmed by coelioscopy or laparotomy (n = 279). For each case, the first woman who delivered in the same center following the operation of the index-case was eligible as a control. When the woman selected as a control refused to be interviewed (n = 7), the woman immediately following who delivered in the same center was taken instead.

The interview collected standardized information on reproductive history, birth control practices history, sexual history, medical history including STDs and PID,

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TABLE 1—Risk of Ectopic Pregnancy Associated with Sociodemographic Characteristics

Variables	Controls (n = 279) Number/ Percent of exposed		Cases (n = 279) Number/ Percent of exposed		Crude Odds ratio (95% CI)
Maternal Age (years)					
<20	10	3.6	4	1.4	0.63 (0.18, 2.18)
20–24	47	16.8	30	10.8	1
25–29	114	40.9	80	28.7	1.10 (0.64, 1.89)
30–34	72	25.8	91	32.6	1.98 (1.14, 3.44)
35–40	28	10.0	55	19.7	3.08 (1.61, 5.87)
≥40	8	2.9	19	6.8	3.72 (1.45, 9.57)
Nationality					
French	188	67.4	183	65.6	1
Foreign	91	32.6	96	34.4	1.08 (0.76, 1.53)
Educational Level					
None	13	4.7	11	4.0	0.77 (0.34, 1.78)
Primary	45	16.2	44	15.8	0.89 (0.56, 1.43)
Secondary	151	53.9	165	59.0	1
Higher	70	25.2	59	21.2	0.77 (0.51, 1.16)
Single Woman					
No	254	91.0	253	90.7	1
Yes	25	9.0	26	9.3	1.04 (0.59, 1.86)

surgical history, conditions of conception and sociodemographic characteristics. Maternal cigarette smoking was assessed by the number of cigarettes smoked per day at the time of conception. Information about the main sexual partner included: number of cigarettes smoked per day, educational level, socio-occupational class, and number of STDs during the past six months. Odds ratios (OR) and 95% confidence interval (CI) were used to describe the association between ectopic pregnancy and smoking.[9] Unconditional multiple logistic regression was performed to control for maternity hospital and to adjust for the confounding effects of other exposures.[10] The proportion of cases that can be attributed to cigarette smoking was assessed by the adjusted population attributable fraction calculated with a formula given by Walter,[11] and adapted for multivariate settings by Bruzzi, *et al.*[12]

Results

The main sociodemographic characteristics of cases and controls were similar except for age (Table 1).

A higher proportion of cases (40.1 percent) than controls (29.7 percent) were smokers at the time of conception (OR = 1.64, 95% CI: 1.15, 2.33). Furthermore, when smoking was analyzed as a categorical variable, we observed a clear dose gradient relationship between cigarette smoking and ectopic pregnancy (Table 2) (OR = 1.21 to 1.64, trend tendency $p < 0.05$). Variables adjusted for in the logistic regression model included: age, appendectomy, prior ectopic pregnancy, prior tubal surgery, prior spontaneous abortion, previous use of IUD, PID, induced conception cycle, use of IUD, combined contraceptive pill or progestative micropill at the time of conception. Adjustment slightly increased the crude estimates (Table 2). On the other hand, there was no association with partner's smoking (OR = 0.82, 95% CI: 0.58, 1.16). Since the adjusted OR of the ectopic pregnancy association with cigarette smoking was 1.68 and the prevalence of smoking among the controls was 0.30, the adjusted population attributable fraction in our population was 17 percent.

Discussion

We found an increased risk of ectopic pregnancy in women who were smokers at the time of conception. This association is supported by the dose-response relationship observed even after adjustment for identified confounding variables. Conversely, no such association was found with partner's smoking, an association not previously investigated. These results seem to eliminate possible masked behavioral confounding factors and strengthen the argument that cigarette smoking was a true direct risk factor of ectopic pregnancy.

Several potential sources of bias must be considered. Since cases and controls had similar demographic characteristics and since adjustment for the center was performed, selection bias is probably limited. However, recall bias which may have led to an overestimation of the risk, bias associated with the misclassification of the recent quitters (probably small according to Chow),[7] and the confounding effects of unidentified risk factors cannot be totally excluded.

Our findings are consistent with six previous epidemiological studies which collected information on maternal smoking habits.[3-8] Despite methodological differences, these studies all found a positive association. Chow, *et al*,[7] found a positive association between smoking at the time of conception and ectopic pregnancy (adjusted OR = 2.2), but failed to demonstrate a dose-response relationship. In the study of Handler, *et al*[8], the estimated relative risk associated with smoking rose from 1.4 for a woman smoking fewer than 10 cigarettes per day to 5.0 for 30 or more cigarettes per day. In that study, however, smoking was assessed during pregnancy. Because the pregnancies of the controls were longer, these women had greater possibility than cases to stop smoking during pregnancy and this may have led to an overestimation of the relative risk.

Alterations of tubal motility and ciliary function following injections of nicotine have been demonstrated.[13] Nicotine also delays blastocyst implantation and alters spacing of implantation sites[14] in animals. The possible role of low estrogen-levels is advocated by some authors.[15] Several findings support this hypothesis: women smokers have lower estrogen-levels than controls[16] and tubal contractions are clearly under estrogenic control.[17] Another explanation for the deleterious effect of smoking involves the reduced immunity in cigarette smokers.[18,19] The altered immunity may affect the tubal response to inflammation, resulting in an increased frequency of PID.[7] However, the association between smoking and PID has not yet been extensively explored in epidemiological studies.

Our observed population attributable fraction of nearly 20 percent indicates the public health importance of this association. If a factor is a causal agent of the disease, the reduction in the rate which would occur if exposure is prevented is equal to this proportion.[11]

In conclusion, our study provides a supplementary argument for the existence of a causal link between cigarette smoking and ectopic pregnancy. Smoking is widespread among women in many countries. In some cases, the prevalence among young women is ever increasing.[20,21] The

TABLE 2—Risk of Ectopic Pregnancy Associated with Cigarette Smoking

Variables	Controls (n = 279) Number/Percent of exposed		Cases (n = 279) Number/Percent of exposed		Crude Odds ratio (95% CI)	Adjusted* Odds ratio (95% CI)
Current Smoking† (woman)						
No	194	69.5	160	57.3	1	1
Yes	83	29.7	112	40.1	1.64 (1.15, 2.33)	1.68 (1.11, 2.55)
Unknown	2	0.8	7	2.6		
Number of Cigarettes/Day§ (woman)						
0	194	69.5	160	57.3	1	1
1–10	40	14.3	40	14.3	1.21 (0.75, 1.97)	1.30 (0.73, 2.32)
11–20	37	13.3	60	21.5	1.44 (1.24, 3.11)	1.95 (1.14, 3.34)
>20	6	2.1	12	4.3	1.64 (0.89, 6.60)	2.49 (0.79, 7.82)
Unknown	2	0.8	7	2.6		
Partner's Smoking						
No	120	43.0	130	46.6	1	
Yes	129	46.2	114	40.8	0.82 (0.58, 1.16)	
Unknown	30	10.8	35	12.6		
Number of Cigarettes/Day (partner)						
0	120	43.0	130	46.6	1	
1–10	39	14.0	36	12.9	0.85 (0.50, 1.43)	
11–20	73	26.2	62	22.2	0.78 (0.52, 1.19)	
>20	17	6.0	16	5.7	0.93 (0.42, 1.80)	
Unknown	30	10.8	35	12.6		

*Adjusted on maternity hospital, maternal age, appendectomy, prior EP, prior tubal surgery, prior spontaneous abortion, previous use of intrauterine device (IUD), pelvic inflammatory disease, induced conception cycle, use of combined estroprogestative pill, IUD and progestative micropill at the time of conception.

†Smoking status at the time of conception.

§When smoking (number of cigarettes/day) was modeled as a continuous variable, the OR associated with smoking x + 1 cigarettes/day versus smoking x cigarettes/day was 1.03 (1.01 – 1.05).

link between ectopic pregnancy and smoking should therefore be considered as a public health issue. ☐

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Effects of a Worksite Nonsmoking Policy: Evidence for Increased Cessation

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ABSTRACT

A random sample of employees was surveyed 20 months after a nonsmoking policy was implemented at the New England Telephone Company in 1986. Overall, 21 percent of respondents who were smoking at the time they heard about the policy had quit smoking; 42 percent of quitters said they stopped smoking because of the policy. Cessation was highest among those who reported less smoke in their work area, but was not related to participation in cessation programs. This study suggests that worksite nonsmoking policies may have favorable effects on smoking cessation. (*Am J Public Health* 1991; 81:202–204)

Introduction

As evidence of health risks associated with passive smoking has accumulated, more worksites have adopted policies that restrict smoking.[1] Studies evaluating these policies, largely in health care facilities, have reported that nonsmoking policies are generally well-received, improve air quality, and reduce cigarette consumption.[2–6] However, there is little evidence that nonsmoking policies stimulate smoking cessation, and the generalizability of these findings to other worksites is not known.

On July 1, 1985, the New England Telephone Company, which employed 27,374 persons at approximately 600 sites, announced a company-wide policy restricting smoking. Beginning September 1, 1985, smoking was banned in conference rooms and classrooms and restricted in cafeterias and lounges. On March 1, 1986, smoking was prohibited in all work areas, including individual offices. Smoking areas were designated in cafeterias, lounges, hallways, and restrooms. A full-time field manager was appointed for 18 months to facilitate the implementation and enforcement of the policy. Free onsite smoking cessation classes were offered. This study examines the effects of this smoking policy on employee smoking behavior and perceived air quality.

Methods

Employees were surveyed in November 1987. The self-administered anonymous survey was distributed through company mail to a stratified random sample of 1,599 employees, including 892 nonmanagers (4.3 percent of technicians, operators, and secretarial/clerical staff), 494 (7.7 percent) lower level managers, and 213 (49.9 percent) upper level managers. The overall response rate was 74.5 percent (N = 1,192): 65 percent among nonmanagers, 86 percent among lower level managers, and 84 percent among upper level managers (three responses to job category were missing). Analysis is limited to data from the 1,120 (94 percent) respondents employed when the policy was implemented.

Respondents were asked about their current smoking status and smoking status when they first became aware that the company had or would be establishing a policy about smoking. Quitters were defined as those who were smokers when they first became aware of the policy and were not smoking when surveyed. Smokers included those smoking cigarettes, pipes, or cigars. As an indicator of compliance, respondents were asked about air quality in work and nonwork areas.

Relationships among these variables were examined using chi square analysis. The results are reported by job category wherever significant differences by job status are found. Multiple logistic regression was used to identify predictors of smoking status.[7] Analyses were conducted using the software program SYSTAT.[8]

Results

Characteristics of the sample are presented in Table 1. Overall, 79 (21 percent) of the 375 respondents who were smokers when they first became aware of the policy said they were not smoking by the time of the survey 20 months later, including 15 percent of nonmanagers, 25 percent of lower level managers, and 32 percent of upper level managers (chi square = 8.6, p < .01). Omitting short term quitters (N = 13), 18 percent had quit for at least three months. Differences in smoking status by job category are not explained by age or

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TABLE 1—Characteristics of the Sample

Demographics	% Nonmanagers	% Lower Level Managers	% Upper Level Managers
Sex	(n = 524)	(n = 407)	(n = 177)
Female	52.5	41.5	16.9
Male	47.5	58.5	83.1
Age (years)	(n = 526)	(n = 410)	(n = 177)
18–29	8.0	4.4	1.1
30–39	36.1	30.0	12.0
40–49	31.2	37.1	39.0
50+	24.7	28.5	42.9
Smoking Status When Respondent First Heard About the Policy	(n = 528)	(n = 411)	(n = 177)
Current Smoker	33.7	34.8	29.9
Former Smoker	30.7	33.8	42.4
Never Smoker	35.6	31.4	27.7
Present Smoking Status	(n = 528)	(n = 411)	(n = 177)
Current Smoker	29.7	27.3	20.9
Former Smoker	35.0	42.1	52.4
Never Smoker	35.2	30.7	27.1

Note: A total of 79 persons who were smoking when they first heard about the policy were not smoking when the survey was administered. Also, eight who reported former smoking and three who reported never smoking when they heard about the policy reported current smoking at the time of the survey.

sex, based on logistic regression analyses. Results of a multiple logistic regression analysis indicate that smoking cessation was more common among those reporting less smoke in work and nonwork areas (Table 2).

The policy was effective in reducing reported exposure to smoke in work areas but not in nonwork areas (Table 3). These results varied significantly by smoking status but not by job category.

Employees classified as smokers were asked: "Which of the following best describes the effect the company's policy about smoking at work has had on your smoking?" Of the 375 smokers, 32 (9 percent) reported that they quit smoking due to the policy, including 20 percent of upper level managers, 9 percent of lower level managers, and 6 percent of nonmanagers. This represents 42 percent of those who quit. In addition, 113 of 375 (32 percent) said that they reduced the number of cigarettes smoked as a result of the policy, including 36 percent of upper level managers, 34 percent of lower level managers, and 29 percent of nonmanagers.

Overall, 38 percent of respondents classified as smokers received some kind of cessation-related assistance. Smokers seeking help were no more likely to quit than those not seeking help (21 percent vs 20 percent). This result did not differ significantly by job category.

TABLE 2—Logistic Regression: Smoking Cessation,[1] with Independent Variables

Variable	Odds Ratio (95% CI)
Job Status Dummy1[2] (non-managers)	1.34 (.50, 3.54)
Job Status Dummy2[2] (managers)	.83 (.32, 2.11)
Number of Cigarettes	.98 (.95, 1.00)
Smoke in Work Areas[3]	1.42 (1.04, 1.94)
Smoke in Non-Working Areas[4]	1.42 (1.03, 1.95)
Age	.82 (.58, 1.16)
Sex	1.13 (.61, 2.09)

Model chi-square 23.89, df = 7 Significant at .01 level

1. Smoking Cessation among those who were smokers when they first heard about the policy.
   1 = Current Smoker
   2 = Former Smoker
2. Upper level managers serve as the reference category for these dummy variables.
3. "How often do you notice smoky air *in your immediate work area*?"
4. "How often do you notice smoky air *in non-work areas* like hallways, rest rooms, etc?"

Discussion

A major finding of this study was the overall quit rate of 21 percent over 20 months which is markedly higher than the expected population quit rate of 2 to 5 percent per year.[9,10] In addition, 42 percent of quitters said their cessation was a direct effect of the policy. Cessation was associated with working in areas of good policy compliance, as measured by perceived air quality, but not with participating in cessation classes.

The strengths of this study include data collection from a random sample of employees and retrospective cohort data on cessation. The response rate to the survey was high (75 percent) although it was higher among managers than nonmanagers. Limitations of the study include retrospectively collected data, which risks recall bias. However, a recent study reported 87 percent agreement between recall of smoking status 20 years ago and longitudinal records.[11] Assessment of smoking cessation was based on self-report, but anonymity of responses gave little motive to distort answers. Differing employee turnover rates between smokers and nonsmokers may have inflated cessation rates; however, only 1 percent of managers surveyed knew of any employee who had left the company due to the policy, and the smoking rate of new hires was higher than in established employees. Finally, there was no comparison company to control for secular trends and our results are compared only with reports from population-wide data.

These findings differ from earlier reports from studies in health care settings, which found no relationship between smoking policies and cessation. Findings from health care settings may not apply to other settings; smokers in health care settings may be more aware of the dangers of smoking and consist of a hard core group more resistant to change. These findings suggest that a well implemented worksite smoking policy, which is fully supported by management and accompanied by cessation classes, may be followed by apparent increases in smoking cessation by employees. ☐

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TABLE 3—Effect of Smoking Policy on Air Quality

	% Current Smoker	% Former Smoker	% Never Smoker	Total
In Work Areas[1] (p = .0001)	(n = 300)	(n = 445)	(n = 350)	(n = 1095)
Improved Air Quality	55.7	71.7	76.0	68.7
Worsened Air Quality	.7	2.0	3.7	2.2
No Effect	43.7	26.3	20.3	29.1
Total	100.0	100.0	100.0	100.0
In Non-work Areas[2] (p = .0001)	(n = 297)	(n = 436)	(n = 340)	(n = 1081)
Improved Air Quality	22.2	23.4	19.0	21.7
Worsened Air Quality	32.7	50.7	55.5	47.3
No Effect	45.1	25.9	25.6	31.1
Total	100.0	100.0	100.0	100.0

1) "What effect do you think the policy about smoking at work has had on the air quality in *your immediate work area*?"

2) "What effect do you think the policy about smoking at work has had on the air quality *in non-work areas like hallways, rest rooms, etc?"*

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Are People More Health Conscious? A Longitudinal Study of One Community

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ABSTRACT

Secular changes in cardiovascular health awareness, knowledge and behavior were observed in four biennial cross-sectional surveys and a cohort survey in a New England community. These changes are not related to more health promotion activities in the social milieu of respondents, but are more likely due to national mass media health campaigns, the effects of which may influence outcomes of community-based cardiovascular disease prevention studies. (*Am J Public Health* 1991; 81:203–205)

Introduction

Communication campaigns designed with the objective of improving the health status of a target population have become more prevalent in the past two decades.[1-8] Many of these campaigns have been based on the assumption that people will behave in prescribed ways given sufficient information and motivation to support such decisions. An understanding of how these national campaigns are currently affecting awareness, knowledge and behavior related to cardiovascular disease (CVD) and its risk factors is important for studies that will examine risk factor changes and morbidity/mortality in study populations.

The setting for this work is the Pawtucket Heart Health Program.[5,9] In this paper, the question of whether residents of the comparison community have become more health conscious—especially with respect to CVD—is the focus.

Methods

The Pawtucket Health Heart Program conducts a series of biennial surveys to assess relevant behaviors and cardiovascular risk factors in the study communities. Each of these surveys includes interviews and physiologic assessments of approximately 1,250 citizens between the ages of 18 and 65 in each of two New England cities, and spans the entire year in order to control for seasonal differences in physiologic risk factors. Households (defined as in the United States Census) are randomly sampled in each city using current listings known to be at least 95 percent complete. A single respondent from age-eligible members of the household is selected using tables adapted from Kish[10] and Deming.[11] A 15–20 minute interview includes questions about diet, exercise, smoking, CVD knowledge, availability of CVD-related programs, and sociodemographic characteristics. Measurements of height and weight, pulse, and blood pressure, and a 30 ml blood sample for later analysis of total cholesterol, triglycerides and HDL-cholesterol, are also obtained. The survey methods and their reliabilities are discussed in detail elsewhere.[12]

The data presented in this paper were collected in the four cross-sectional surveys conducted in the comparison city in 1981–82, 1983–84, 1985–86, and 1987–88. In addition, respondents to survey 1 were resurveyed after a lapse of five years: 61.3 percent completed the second examination. Each respondent was reexamined within one calendar month of the date of their first examination.

The percentage of participants answering favorably to questions were considered as dependent variables for surveys. Physiologic variables will not be analyzed until the final surveys are completed. Potential covariates employed in the analyses were: age, gender, education, language spoken at home, ethnicity, marital status, employment status, and household income level.

The objectives of this report are to document awareness, knowledge and behavior changes over time and determine trends. To measure the linear trend, the slope was calculated by weighted linear regression for each dependent variable, and tested with the Chi-square statistic.[13,14]

To adjust for potential covariate effects, eight groups were constructed. The cutpoints were investigated carefully so that: (a) each group had enough observations, and (b) the differences between distribution of surveys were preserved. The linear trend was calculated for each group and then an adjusted overall measure of linear trend across all groups was taken as the weighted average of the eight trends.[15]

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TABLE 1—Results of Cross-sectional Survey Questions Regarding Awareness and Behavior Related to CVD Prevention, and Results of Linear Trend

Variables	S1 (1280)	S2 (1442)	S3 (1484)	S4 (864)[a]	X^2	b	SE (b)
Is it possible to prevent CVD	83.8	87.4	88.5	91.9	31.816**	.0250	4.432×10^{-3}
Methods(s) Mentioned:							
▶ Quit Smoking	44.4	41.3	44.9	45.1	.688	.0059	7.113×10^{-3}
▶ Cut salt intake	13.0	15.1	16.6	18.5	11.963**	.0181	5.233×10^{-3}
▶ Cut fat intake	27.8	45.1	55.3	63.5	272.970**	.1189	7.197×10^{-3}
▶ Cut calories	8.5	4.8	6.1	6.4	2.288	−.0053	3.504×10^{-3}
▶ Increase exercise	39.7	45.0	53.0	52.8	47.890**	.0498	7.196×10^{-3}
▶ Control weight	32.0	32.0	28.6	27.6	6.643*	−.0170	6.596×10^{-3}
▶ Control blood pressure	10.8	10.5	11.2	8.4	1.439	−.0053	4.418×10^{-3}
▶ Control stress	29.6	29.7	30.1	24.7	3.416	−.0121	6.547×10^{-3}
Do not know own risk of CVD	8.9	9.1	8.8	8.2	.292	−.0021	3.886×10^{-3}
Do not know own BP level	8.4	9.9	10.8	11.0	5.023*	.0091	4.051×10^{-3}
Do not know own CHOL level	35.0	37.7	35.9	25.3	16.194**	−.0258	6.411×10^{-3}
In last year, have:							
▶ Had CHOL measured	11.6	12.3	13.2	16.3	9.597**	.0141	4.551×10^{-3}
▶ Attempted weight loss	48.8	50.7	51.1	46.4	.353	−.0040	6.732×10^{-3}
▶ Maintained loss	56.6	54.9	59.9	57.1	.890	.0091	9.646×10^{-3}
▶ Increased exercise	30.0	32.8	32.7	34.5	4.402*	.0133	6.315×10^{-3}
▶ Maintained increase	59.1	57.7	55.8	59.4	.063	−0.0030	11.952×10^{-3}
Current cigarette smoker	42.8	39.9	39.4	36.0	9.371**	−.0202	6.599×10^{-3}
▶ Attempt to quit in past 12 mos.	41.1	45.6	48.5	44.4	2.704	.0175	10.642×10^{-3}
Live with smoker	38.4	38.8	36.5	35.3	3.079	−.0115	6.554×10^{-3}
Limit salt intake	65.8	71.2	67.9	67.6	.187	.0027	6.244×10^{-3}
Limit fat intake	63.3	66.5	68.5	66.9	5.288*	.0147	6.379×10^{-3}
Never encourage others to							
▶ Stop smoking	24.1	21.3	21.3	21.9	1.745	−.0074	5.602×10^{-3}
▶ Lose weight	28.6	24.2	27.0	26.2	.556	−.0044	5.901×10^{-3}
▶ Cut salt/fat intake	38.0	28.4	31.5	29.9	12.293**	−.0221	6.297×10^{-3}
▶ Exercise more	36.1	30.7	32.4	29.5	7.673**	−.0175	6.314×10^{-3}
Membership organization offered health programs in past year	16.5	17.1	17.7	18.9	1.986	.0076	5.393×10^{-3}
▶ Nutrition	19.7	17.3	17.5	18.9	.041	−.0027	13.334×10^{-3}
▶ Stress	4.8	9.7	18.8	12.1	10.770**	.0358	10.909×10^{-3}
▶ Weight	25.0	18.9	31.2	27.7	2.622	.0240	14.822×10^{-3}
▶ Exercise	35.1	40.7	38.0	41.2	.780	.0146	16.531×10^{-3}
▶ Blood Pressure	17.0	18.1	13.7	6.8	8.076**	−.0339	11.933×10^{-3}
▶ Smoking	16.0	15.9	26.5	31.8	17.376**	.0586	14.058×10^{-3}

[a] Due to budgetary constraints, S4 was extended to two years. Only data from the first half of the survey (1987–88) are reported.
*$p \leq .05$
**$p \leq .01$
Results expressed as percentages unless otherwise noted.

Results

A total of 5,070 persons participated in one of the cross-sectional surveys in the comparison city. Preliminary analyses were performed for each covariate. Gender distribution and marital status were similar across the four surveys with females comprising 58 percent of the overall sample; approximately 60 percent of respondents were married.

Significant differences among the four surveys were noted for age group distribution, years of education and proportion of employed. Survey participants at the last survey tended to be younger, better educated and more often employed compared to the first one.

Persons of Portuguese descent comprised about 45 percent of the sample in each survey, and only 73 percent of the sampled population spoke English. There was no indication of significant changes in these variables across the surveys.

Using the weighted regression analyses to detect linear trends in CVD knowledge and behavior, a number of significant effects were found (see Table 1). When each of these linear relationships was adjusted for the covariates (i.e. age, education level and employment status), similar trends were found for each variable.*

The expected changes in the population from regression analysis of changes in the cross-sectional surveys were compared with the actual changes found among cohort survey respondents.* The data indicate that, in most cases, the observed change in the cohort exceeded the expected value derived from the cross-sectional surveys.

Discussion

These results support the conclusion that important secular changes are occurring in cardiovascular health awareness, knowledge and behavior. It appears that such effects are not due to the increased presence of prevention programs either at participants' worksites or religious and social organizations and are likely attributable to programs mediated through electronic and print mass media.

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*Data available on request to authors.

Respondents in the cohort survey demonstrated greater changes in health promotion knowledge and behavior than expected from cross-sectional survey data. This may reflect a self-selection bias among those persons who were reexamined, although the first examination may also have induced more health consciousness among this group.

The large proportion of persons of Portuguese heritage is a factor that limits generalizing these data to other sections of the region or country. The high proportion of respondents who spoke a foreign language at home raises the possibility that our estimates of the "secular trend" for CVD prevention-related awareness, knowledge and behavior are conservative. In more homogeneous, affluent, and educated communities, even greater effects may have occurred in the six-year period studied here.[16]

These observations support other studies of changes in awareness, knowledge and behavior among the general public.[8] That these changes are occurring in a city that serves as a comparison area for a population-based CVD research and demonstration project may reduce the power to detect the effects of intervention in the intervention community.[17-21] ☐

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Sexual Risk Behaviors, AIDS Knowledge, and Beliefs about AIDS among Runaways

Mary Jane Rotheram-Borus, PhD, and Cheryl Koopman, PhD

ABSTRACT

Sexual risk behaviors, knowledge of acquired immunodeficiency syndrome (AIDS), and beliefs about AIDS prevention were examined among 126 runaways. In the previous 3 months, 65 percent of youths had been sexually active. Among the sexually active runaways, males reported a median of 2.7 partners and females reported 1.3 partners, and only 18 percent reported consistent condom use. Runaways demonstrated moderately high AIDS knowledge and beliefs endorsing AIDS prevention. Condom use and abstinence were directly related to beliefs about preventing AIDS. (*Am J Public Health* 1991;81:206–208)

Introduction

In 1988, runaways in New York City (NYC) were found to have human immunodeficiency virus type 1 (HIV-1) seropositivity rate of 6.7 percent.[1] This finding identified runaway youths as a high-risk group for HIV-1 infection. To design effective prevention programs, more information is needed on the sexual risk behaviors of these youths. However, empirical data documenting their risk behaviors are limited to a few items in epidemiological studies of runaways.[2–4]

Knowledge of AIDS and beliefs about AIDS prevention are relevant to reducing HIV-1 infection.[5,6] Therefore, the goals of this paper were to document runaways' current sexual risk behaviors, knowledge, and beliefs about preventing AIDS, and to examine the relationships among these findings.

Methods

Sample

The sample includes consecutive admissions to two of three residential shelters for runaway youths in Manhattan and Brooklyn over an 8-month period in 1988–89, for a total of 64 males and 66 females. They were recruited by two young adult Black interviewers, one male and one female, of whom both had intensive training in psychosexual assessment.[7] Two runaway males refused to participate in the study. Each sample contained primarily Black (65 percent) and Hispanic youths (28 percent). They ranged in age from 11 to 17, and 70 percent were born in NYC. The average age was 15.7 (SD = 1.5), and the median education completed was sophomore year of high school. Only 22 percent of runaways had ever lived "on the street"; however, 75 percent had not lived with a parent or guardian for at least 2 weeks.

Sexual Risk Behavior Assessment

A semistructured interview guide, *the Sexual Risk Behavior Assessment Schedule–Youth* (SERBAS),[8] was used to elicit information about sexual behavior. In this study, assessments of current sexual activity were limited to acts in which the exchange of semen or vaginal fluid was possible (i.e., oral, anal, and penile-vaginal intercourse), although these acts may not be of equal risk. Sexual behaviors assessed over the previous 3 months included abstinence, number of sexual partners, number of sexual encounters, and frequency of condom use (assessed on a 4-point scale based on number of sexual encounters divided by instances of condom use). Test-retest reliability conducted on items readministered to 22 runaways after 1 week was high (r ranged from 0.71 to 1.00).

General Knowledge about AIDS

A true-false instrument containing 62 items was used to assess general AIDS knowledge. The process of developing the instrument helped to address its validity, resulting in high internal consistency and test-retest reliability, as described elsewhere.[9] This instrument covers six domains: definitions, outcomes, risk behavior, transmission, prevention, and HIV-1 testing.

Beliefs about Preventing AIDS

Beliefs about AIDS and safer sex practices were assessed with 39 Likert-type items. This measure was developed in parallel procedures with the AIDS knowledge instrument. Previous research[9] using this instrument with runaway adolescents showed that it has high internal consistency. It covers five domains: peer support for safe acts, self-efficacy, self-control, perceived threat, and expectation of acting to prevent pregnancy, which is included because some of

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TABLE 1—Frequencies of High-Risk Sexual Behavior during the Past 3 Months among Sexually Active Runaways*

Behavior	Males (N = 44)	Females (N = 37)
Sexually active	70%	59%
Number of partners		
Median	2.7	1.3
Mean ± SD	4.7 ± 6.0	2.0 ± 3.1
Number of sexual occasions		
Median	9.0	5.3
Mean ± SD	14.9 ± 20.6	9.9 ± 12.8
Condom use, percent		
Never	27.0	47.2
Sometimes	35.1	13.9
Most of the time	21.6	19.4
Always	16.2	19.4

* Sexual activity includes oral, anal, and vaginal intercourse. Data apply only to sexually active runaways. Thirty percent of the 63 male runaways and 41 percent of the female runaways in the total sample reported no sexual activity.

TABLE 2—Means and Standard Deviations of General Knowledge of AIDS and Positive Beliefs about Preventing AIDS among Male and Female Runaways

Variable	Males (N = 61)	Females (N = 64)
General knowledge	73% ± 12.9%	74% ± 11.6%
Belief domains		
Total positive beliefs	120.2 ± 13.6	122.3 ± 14.5
Peer support	16.1 ± 3.2	16.0 ± 3.8
Self-efficacy	63.4 ± 8.4	63.3 ± 7.7
Perceived threat	10.4 ± 2.0	10.4 ± 1.8
Self-control	16.2 ± 2.8	17.0 ± 1.8
Prevent pregnancy	14.7 ± 3.0	15.6 ± 3.8

the major strategies for preventing pregnancy (abstinence, avoiding sexual intercourse, and condom use) also reduce risk for HIV-1 infection.

Data Analysis

The frequencies of high-risk sexual behaviors were calculated for male and female runaways. One male and three females who reported exclusively homosexual activity were removed from analyses of sexual risk behaviors because their sexual behavior was not comparable to that of the heterosexual runaways. Chi square tests were computed on sexual risk behaviors, splitting the data on the number of sexual partners and number of sexual encounters at the joint median. T-tests examined gender differences on AIDS knowledge and on overall and domain scores for beliefs about AIDS prevention. Regressions were computed between overall knowledge and belief domain scores with sexual risk behaviors.

Results

The majority of these high-risk youths had been sexually active in the previous 3 months (see Table 1). Sexually active males reported a median of 2.7 sexual partners and 9.0 sexual encounters, and sexually active females reported a median of 1.3 sexual partners and 5.3 sexual encounters; 65 percent of the females and 32 percent of the males had only one partner. Among the sexually active youths, consistent condom use was low, although 47 percent of males and 44 percent of females reported using a condom the last time they had sexual intercourse. No runaways reported bisexual activity in the previous 3 months.

Table 2 shows the overall AIDS knowledge scores and overall and domain-specific beliefs of male runaways and female runaways. Youths showed moderately high general knowledge ($\bar{X}$ = 45.4, SD = 7.6, [a score that reflected 73 percent accurate knowledge]). Positive beliefs about preventing AIDS were also high ($\bar{X}$ = 121.4, SD = 14.1, [reflecting a 70 percent positive endorsement of safe acts]). There were no significant differences between the male and the female runaways on these measures.

Although the sexual risk behaviors were not significantly related to overall AIDS knowledge, condom use showed a weak inverse relation to perceived threat (B = −.17, 95 percent CI = −.33, −.01), and expecting to act to prevent pregnancy was positively associated with condom use (B = .14, 95 percent CI = .07, .22) and with abstinence (B = .05, 95 percent CI = .02, .07).

Discussion

Because previous research[3] has shown that intravenous (IV) drug use is not high among runaways in NYC, sexual activity is likely to be their primary risk behavior for HIV-1 transmission. The runaways' sexual risk behaviors, AIDS knowledge, and beliefs about AIDS do not provide a sufficient explanation for the high seroprevalence rate reported in 1988 (6.7 percent). Even though the runaways evaluated in this study were drawn from a residential shelter other than the one where the 6.7 percent seroprevalence rate was found, there is no reason to believe that the youths in our sample differ from those in the prevalence study. They were similar in age, ethnicity, and socioeconomic status, and many had been seen at the shelter where the seroprevalence study was conducted.

While most (65 percent) had been sexually active during the previous 3 months, the rate was not dramatically different from the percentage of a comparable sample of high school students who had been sexually active in the previous 6 months (58 percent).[10] Although condom use was relatively inconsistent, again, it was not different from condom use among adolescents in general.[11] Sexually active runaway girls typically have reported only one partner in the past 3 months. Furthermore, runaways' moderately high knowledge and positive beliefs about AIDS prevention were similar to those of high school samples.[10,12] This pattern of results suggests the need for more detailed studies examining the social networks from which these youths draw their sexual partners. Future research must also examine this population's drug use, including IV drug use, needle sharing, and crack use, as well as their exchange of sex for drugs or money.

These data do point to the importance of developing specialized programs for male runaways. Males have significantly more sexual partners compared with runaway females, consistent with findings on the number of lifetime sexual partners in a national sample of male adolescents.[13] However, the percentage of males in the study who used a condom the last time they had sexual intercourse (47 percent), was less than reported by adolescent males in a national survey (58 percent).[14]

Consistent with previous research,[15] we found moderate relationships between beliefs about preventing AIDS and sexual risk behaviors. Although as a group, the runaways had a fairly high knowledge of AIDS and had positive beliefs about AIDS, some youths were relatively uninformed. Interventions with these youths may impact behavior. ☐

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Security Measures for AIDS and HIV

Carl G. Torres, PhD, Mark E. Turner, MPH, John R. Harkess, MD, and Gregory R. Istre, MD

ABSTRACT

This study describes the measures being taken by AIDS surveillance offices across the country to ensure the security of information regarding patients with AIDS and HIV infection. Security measures were evaluated according to the cumulative number of AIDS cases reported, whether partner notification services were provided, and whether HIV seropositive reporting by name was also required. This study showed that public health departments have taken extra steps to ensure the security of AIDS and HIV data. (*Am J Public Health* 1991; 81:208–209)

Introduction

Public health surveillance for acquired immunodeficiency syndrome (AIDS) and human immunodeficiency virus (HIV) infection has accentuated the need for confidentiality and security of health records. This study describes the measures being taken across the country to ensure the security of information regarding patients with AIDS and HIV infection reported to public health departments. Security measures were evaluated according to the cumulative number of AIDS cases reported, whether partner notification services were provided, and whether HIV seropositive reporting by name was also required.

Methods

The study population comprised all 66 AIDS surveillance offices responsible for reporting to the Centers for Disease Control as of July 1, 1989. These offices were located in 13 city/county health departments, all 50 state health departments, the District of Columbia, Puerto Rico, and Guam. Confidential questionnaires solic-

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TABLE 1—Security Measures for Case Reports and Computerized Data with Personal Identifiers in 63 AIDS Surveillance Offices, 1989

	%	N	%
Case Report Security Measures			
Reports stored in a locked file cabinet or safe	100		
Additional locking system	23		
Fire-proof cabinet	44		
File cabinet in a restricted area	87		
Offices with any one or more of above three			91
Alarm system for the storage area	8		
Alarm system for the building	54		
Security guard in the building during non-working hours	70		
Offices with any one or more of above three			83
Median number of employees with access to restricted area	7	(2–30)*	
Median number of employees with access to data	3	(1–15)*	
	%	**Ñ**	**%**
Computerized Data Security Measures for Offices with Personal Identifiers in Their Computer System, N = 54 (86%)			
Use security key lock	74		
Computer in a restricted area	78		
Computer bolted in a permanent location	17		
Use a removable hard drive system	15		
Use special software to control access to the computer	54		
Computer data encrypted	17		
Offices with any one or more of above six			98
Alarm system for computer area	7		
Alarm system for the building where computer is located	50		
Offices with any one or more of above two			52
Median number of employees with access to restricted area	6	(2–30)*	
Median number of employees with access to computer data	3	(1–5)*	
Median number of identification codes and passwords used	2	(1–3)*	

*Range

iting information regarding security measures used to protect AIDS and HIV data were sent in mid-July 1989. A reminder letter was sent in mid-August 1989 and reminder telephone calls were placed during the last week of August 1989. Security measures were examined by the number of cumulative AIDS cases reported to the specific office as of June 30, 1989 (less than 500, between 500 and 1,500, and greater than 1,500), whether provider referral partner notification (PRPN) was offered, and whether HIV seropositive reporting by name was required.

Results

Questionnaires were returned by 63 (95 percent) of 66 AIDS surveillance offices. All offices maintained their records in locked cabinets. In addition, an array of other measures were employed to protect written and computer records (Table 1). Where all HIV infections were reportable, 95 percent of the offices handled HIV reports in the same way as their AIDS case data. There were 26 offices with fewer than 500 AIDS cases reported, 20 offices with 500 to 1,500 cases, and 17 offices with over 1,500 cases. Forty-six offices (73 percent) provided PRPN. The median number of AIDS cases reported in offices with PRPN was 499, while the number for offices without this service was 1,400. Reporting of all HIV infections was required by 21 offices. The median number of AIDS cases in the 21 offices was 550, while in the offices without HIV reporting the median number was 1,273. The proportion of security measures utilized did not differ significantly with respect to the cumulative number of AIDS cases reported, whether PRPN was offered, or whether all HIV infections were reportable.

Discussion

This study showed that public health departments have taken steps to ensure the physical security of records regarding patients with AIDS and HIV infection. As a minimum, records were maintained in locked cabinets, however, most offices had instituted additional safeguards, such as restricting access to areas where AIDS records are stored, bar locks, alarms, and computer security systems.

No statistically significant differences were found in the proportion of security measures with respect to the cumulative number of AIDS cases reported, whether PRPN was offered or whether reporting of HIV infection was required. This indicates that the implementation of PRPN and HIV reporting is being done without compromising the physical security of records. The results of this study provide a tool with which public health departments and others holding highly sensitive personal health data can appraise the measures taken to ensure the security of their records. Although this study does not address procedures being taken to ensure security of data among field staff or in settings outside public health departments, it does indicate that public health officials are taking extra measures to ensure the physical security of data regarding patients with AIDS and HIV infection. ☐

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Discharges against Medical Advice at Regional Acute Care Hospitals

David Barton Smith, PhD, and Joel Leon Telles, PhD

ABSTRACT

Data from 67 acute care hospitals in the Philadelphia metropolitan area indicate that there were 7,613 discharges against medical advice (AMA) in fiscal year 1987, or 1.20 percent of all discharges that year. Diagnosis-related group (DRG), type of insurance, and sex had independent effects on the rate of AMA discharges. Urban community hospitals had the highest percent of AMA discharges. Previous studies, done in teaching facilities, may have underestimated the rate of AMA discharges. (*Am J Public Health* 1991; 81:210–213)

Introduction

Discharges against medical advice (AMA) represent a frustrating problem for the individual physician and hospital, and an overlooked indicator of potential problems facing the organization of public health services in a region. Little systematic analysis of the subject has been published. Most reports have been anecdotal or limited to specific diagnostic groups within a few selected institutions.[1-3] The only published general estimate, based on a 2-year review of records in a major teaching institution, reported that patients who were discharged AMA accounted for about 0.8 percent of discharges.[4] We analyzed regional data to describe regional patterns and, because larger numbers were involved, to help clarify the relative influence of factors associated with variation in AMA rates.

Methods

A systematic description of patients discharged against medical advice from acute care hospitals was generated from the comprehensive regional inpatient data base constructed directly from hospital abstract tapes supplied to the Delaware Valley Hospital Council. We analyzed the data on the 635,897 patients discharged from all 67 acute care hospitals in the Greater Philadelphia area between July 1, 1986, and June 30, 1987. We used a linear modeling approach, applying the categorical modeling procedure in the SAS statistical package, to estimate the independent effects of diagnosis-related group (DRG), payment method, and sex on the percent of AMA discharges.[5,6]

Results

A total of 7,613 cases, or 1.20 percent of inpatient discharges, were listed as discharged AMA. Males were more than twice as likely as females to be discharged AMA (Table 1). Patients who were covered by the Medicaid program or who had no insurance were three times as likely to be discharged in this manner.

AMA discharges were concentrated in a few diagnostic categories. Table 2 lists the 20 DRGs with the highest frequency of AMA discharges according to the Medicare prospective-payment grouper procedure in effect October 1, 1987, to September 30, 1988.[7] These 20 DRGs accounted for 60.7 percent of AMA discharges. Major diagnostic category (MDC) 20 (DRG 433-437), alcohol and drug use and alcohol- and drug-induced organic mental disorders accounted for 26.6 percent of AMA discharges and was the MDC with highest percentage of patients with such discharges (14.6 percent).

The average length of stay for AMA discharges was about half the average length of stay for all discharges in most of the 20 DRGs. The DRG case weight for all AMA discharges was 0.77, compared with 0.99 for all discharges in the region, suggesting that they were somewhat less severe.[8] However, it is also possible that many such discharges led to later readmissions, as noted in studies of psychiatric facilities.[9]

Among the 20 most frequent AMA discharge diagnoses, diagnosis, insurance status, and sex of the patient had statistically significant ($p < .001$) independent main effects. The Medicaid and self-pay discharges represented underinsured groups in the Philadelphia area with similar patterns of use, and they have been combined in this analysis. The estimate of the percent of AMA discharges for any combination of these three variables can be calculated by adding the individual effects.

Thus, in Table 3, the estimate for the percent of AMA discharges for male Medicaid cases with DRG 430 (psychoses) is 8.00 percent (INTERCEPT [4.12 percent] + DRG [2.19 percent] + MEDICAID/SELF-PAY [1.35 percent] + MALE [.35 percent]. The actual percent of AMA discharges for this group of cases was 7.89 percent, and the standard error for the es-

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TABLE 1—Total Discharges against Medical Advice and Rate per 100 Discharges in the Philadelphia Metropolitan Area, by Source of Payment and Sex

	Female		Male		Total	
Payer	N	Rate/100(%)	N	Rate/100(%)	N	Rate/100(%)
Other[a]	1,281	0.45	2,039	0.91	3,320	0.65
Medicaid	1,290	2.19	2,199	5.31	3,489	3.48
Self-pay	240	1.68	564	4.51	804	3.00
Total	2,811	0.78	4,802	1.73	7,613	1.20

[a] Medicare and private insurance (Blue Cross, health maintenance organizations, and commercial insurers.

timate was 0.24 percent. For all 20 of these discharge diagnoses, estimates of the effect of the DRG category on the percent of AMA discharges ranged from 9.56 percent for substance abuse admissions falling into MDC 20 to −2.29 percent for DRG 243 (medical back problems). The effect of Medicaid or self-pay status (1.34 percent) was almost four times greater than the effect of being male (.35 percent).

AMA discharge rates also varied significantly by the geographic location and the type of facility. Suburban and teaching hospitals had the lowest rates of AMA discharges. Urban community hospitals had the highest rates. Table 4 presents the percent of AMA discharges by type of hospital for the 24 MDCs. Except for the group of specialty facilities (800 beds out of a regional total of 17,555 beds, the majority belonging to two children's hospitals), suburban facilities had the lowest AMA rates. In contrast, the urban community hospitals had the highest percent of AMA discharges (3.49 percent compared with 1.20 percent for the region as a whole). Teaching facilities tended to have lower rates of AMA discharges than community hospitals. The differences in rates of AMA discharges between urban and suburban hospitals and between community and teaching hospitals persist in almost all MDCs.

Discussion

While the analysis confirms the patterns found in the previous case studies of self-selected institutions, it places the findings into a broader perspective.[1–4] Because previous inquiries studied major teaching institutions, they may have underestimated the magnitude of the problem. The 1.2 percent of Philadelphia-area discharges that were AMA is substantially higher than the 0.8 percent found in the previously cited Peter Bent Brigham Hospital study. Urban community hospitals located in areas with the most serious problems of social disorganization (e.g., crime, drug addiction, unemployment) had the highest rates.

AMA rates do not appear to be simply a function of the disease and the nature of its treatment. Males, Medicaid patients, and patients identified as self-paying were more likely to be discharged AMA, independent of diagnosis. They represent a crude measure of therapeutic failure or, at least, failure in the provider-patient relationship. Efforts to reduce these discharges must be balanced against the individual rights of patients to refuse treatment, the legitimacy of some of the personal reasons that motivate them to leave, and the potential harm to the patient of premature discharge.

It is useful to view AMA discharges in the context of overall patterns of use and access to health care. Indeed, there is a striking symmetry between the factors

TABLE 2—AMA Rates and Length of Stay for 20 DRGs with Highest Number of AMA Discharges

DRG #	Code	N	Rate/100 (%)	Average AMA Length of Stay (LOS)	Ratio of LOS to Total[a]
MDC20	Alcohol and drug use and alcohol- and drug-induced mental disorders	2,025	14.59	3.37	0.59
430	Psychoses	686	6.13	7.79	0.48
450	Poisoning and toxic effects of drugs, age >17 without CC	250	10.35	1.20	0.36
140	Angina pectoris	196	1.38	2.60	0.42
449	Poisoning and toxic effects of drugs, age >17 with CC	154	6.58	2.37	0.26
426	Depressive neuroses	152	9.92	5.03	0.33
143	Chest pain	134	2.54	1.88	0.44
127	Heart failure and shock	101	0.72	5.14	0.49
24	Seizure and headache, age >17 with CC	98	3.62	3.20	0.29
204	Disorders of the pancreas except malignancy	95	4.50	4.58	0.33
97	Bronchitis and asthma, age >17 without CC	90	2.26	2.55	0.43
277	Cellulitis, age >17 with CC	87	3.60	4.22	0.38
294	Diabetes, age >35	78	1.89	5.71	0.55
395	Red blood cell disorders, age >17	77	2.29	4.83	0.54
243	Medical back problems	74	0.57	3.87	0.40
182	Esophagitis, gastroenteritis, and miscellaneous digestive disorders, age >17 with CC	73	1.08	3.23	0.33
174	Gastrointestinal hemorrhage, age >70	66	1.99	4.45	0.30
122	Circulatory disorders with acute myocardial infarction	64	1.13	3.95	0.38
96	Bronchitis and asthma age, >70 and/or CC	63	1.35	3.93	0.36
88	Chronic obstructive pulmonary disease	59	1.24	4.98	0.40
Top 20 AMA DRGs		4,622	3.79	3.76	0.39
All regional discharges		7,613	1.20	4.40	0.61

[a] AMA average length of stay divided by average length of stay for all discharges.

TABLE 3—Linear Model Estimates of Main Effects on Percent AMA Discharges

		Effect (%)	Standard Error (%)	AMA Estimate[a] (%)
Intercept		4.12%	0.08%	
MDC20_	Substance abuse and substance-induced organic mental disorders	9.56	0.29	13.68
430	Psychoses	2.19	0.22	6.31
450	Poisoning and toxic effects of drugs, age >17 without CC	5.85	0.57	9.97
140	Angina pectoris	−1.86	0.09	2.26
449	Poisoning and toxic effects of drugs, age >17 with CC	1.78	0.43	5.90
426	Depressive neuroses	5.88	0.71	1.00
143	Chest pain	−1.09	0.18	3.03
127	Heart failure and shock	−2.15	0.09	1.97
24	Seizure and headache, age >17 with CC	−1.20	0.24	2.92
204	Disorders of the pancreas except malignancy	−1.05	0.28	3.07
97	Bronchitis and asthma, age >17 without CC	−1.39	0.20	2.73
277	Cellulitis, age >17 with CC	−1.54	0.21	2.58
294	Diabetes, age >35	−1.64	0.17	2.48
243	Medical back problems	−2.29	0.88	1.83
395	Red blood cell disorders, age >17	−1.45	0.23	2.67
182	Esophagitis, gastroenteritis, and miscellaneous digestive disorders, age >17 with CC	−1.94	0.12	2.18
174	Gastrointestinal hemorrhage with CC	−1.69	0.17	2.43
122	Circulatory disorders with acute myocardial infarction without cardiovascular complications discharged alive	−2.05	0.13	2.07
96	Bronchitis and asthma, age >17 with CC	−2.02	0.13	2.10
Insurance (Medicaid or self-pay)		1.34	0.07	5.46
Sex (male)		0.35	0.03	4.47

[a] Intercept + Main Effect, all effects significant, $p < .001$

TABLE 4—Percentage of Patients Discharged AMA, by Hospital Type and Major Diagnostic Category

		Teaching Hospitals			Community					
		Suburban	City		Suburban	City				
	Major Diagnostic Category	Major	Minor	Major	Minor		Medical School	Other Specialty	Average	
1	Nervous system	0.5	1.1	1.3	1.6	1.0	2.1	1.1	0.0	1.1
2	Eye	0.0	0.0	0.7	0.6	0.1	0.7	0.2	0.0	0.2
3	Ear, nose, and throat	0.0	0.5	0.3	0.4	0.1	0.8	0.4	0.0	0.2
4	Respiratory system	0.6	1.0	1.1	1.3	0.5	2.6	1.2	0.1	1.0
5	Circulatory system	0.6	0.7	1.2	1.0	0.7	2.0	0.8	0.1	1.0
6	Digestive system	0.4	0.6	0.9	0.9	0.5	1.7	0.7	0.0	0.7
7	Hepatobiliary system and pancreas	0.7	0.7	1.8	0.7	1.0	3.7	1.3	0.0	1.4
8	Musculoskeletal system	0.2	0.2	0.6	0.7	0.3	1.1	0.4	0.1	0.5
9	Skin, subcutaneous tissue	0.5	1.1	2.2	1.5	0.5	3.5	1.5	0.0	1.4
10	Endocrine, nutritional and met.	0.5	0.8	1.5	1.1	0.8	2.5	0.8	0.1	1.1
11	Kidney and urinary tract	0.3	0.6	0.8	0.8	0.6	1.2	1.3	0.0	0.8
12	Male reproductive system	0.3	0.1	0.4	0.7	0.3	0.7	0.5	0.4	0.4
13	Female reproductive system	0.0	0.2	0.6	0.3	0.1	0.9	0.4	0.0	0.4
14	Pregnancy, childbirth	0.1	0.0	0.4	0.1	0.2	0.3	0.5	0.0	0.3
15	Newborns and neonates	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1
16	Blood, blood forming and imun.	0.3	2.2	1.6	2.2	1.3	5.2	2.2	0.0	1.7
17	Myeloproliferative, malignancy	0.1	0.0	0.4	0.9	0.1	0.5	0.3	0.1	0.2
18	Infections and parasitic	0.5	0.0	1.5	1.7	0.7	2.8	1.3	0.3	1.1
19	Mental	4.3	4.2	5.0	3.7	7.9	5.3	7.9	1.6	6.4
20	Alcohol/drug use	7.1	14.4	13.4	7.4	12.3	18.7	7.1	0.0	14.6
21	Injuries, poisonings and toxic	2.7	4.9	4.1	6.0	2.6	7.9	1.6	0.2	3.5
22	Burns	0.4	3.6	1.7	1.0	1.0	2.9	3.3	0.0	1.2
23	Factors influencing services	0.9	1.0	0.6	1.4	0.6	3.6	0.3	0.4	0.7
24	Other	0.0	0.0	2.6	0.0	2.0	2.5	0.5	0.0	0.8
	Average	0.55	0.99	1.37	1.00	0.94	3.49	1.0	0.07	1.20

affecting "entrance" to health services (i.e., barriers and delays in seeking care and overall patterns of underutilization) and of the factors affecting AMA discharge rates, which may be viewed as inappropriate "exit" from such services.[10-14]

Since regional data systems are now widely available, it is possible to monitor these processes more systematically. These rates can be linked more directly to the relationships between medical and social problems in regional populations and to the pressures imposed on medical management by different forms of reimbursement as they change the character of inpatient care. AMA discharges represent many of the problems (e.g., those related to drugs, alcohol, psychiatric conditions, and indigent care) that public health agencies address. The percent of AMA discharges may in time take its place among other indicators of incidence rates and use of health services in a population and help document progress (or the lack of it) in solving larger social problems. ☐

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An Evaluation of the Use of the Statewide Planning and Research Cooperative System of New York State as a Resource Planning Tool for HIV Infection

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ABSTRACT

Hospital discharge records of patients with *Pneumocystis carinii* pneumonia (PCP) in New York State were studied to determine whether cases of human immunodeficiency virus (HIV) infection were identified. We estimate that as many as 13 percent of hospitalizations of patients with PCP in 1987 and 10 percent of those in 1988 were not appropriately identified as HIV related. Identification of PCP as HIV related was a function of a hospital's volume of PCP admissions. (*Am J Public Health* 1991;81:213–215)

Introduction

One means of estimating acute care hospital use in New York State by patients infected with human immunodeficiency virus (HIV) has been based on the Statewide Planning and Research Cooperative System (SPARCS).[1] SPARCS, a mainframe data base that has been in existence since 1980, contains a discharge abstract for more than 95 percent of the acute care hospital stays in the state, exclusive of those occurring in federal and psychiatric acute care facilities. The discharge abstracts describe the hospital patient's medical condition in five diagnostic fields, including a principal diagnosis and four secondary diagnoses, using ICD-9-CM diagnostic codes.

In October 1986, new HIV-specific ICD-9-CM codes[2] became effective.[3] The new codes, 042-044, indicate the presence of certain illnesses and/or conditions occurring simultaneously with HIV infection,

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TABLE 1—HIV-Identified PCP Discharges

Year	PCP Discharges (n)	HIV-Estimated PCP[a] (n)	HIV-Estimated PCP[a] (%)[b]	HIV-Identified PCP (n)	HIV-Identified PCP ÷ HIV-Estimated PCP (%)
1987	5,725	5,631	(98)	4,891	(87)
1988	5,093	5,015[c]	(98)	4,509	(90)

Note: Data obtained from the New York State Statewide Planning and Research Cooperative System (SPARCS). Data for 1988 are 80–85 percent complete.

[a] PCP discharges minus non-HIV PCP background.

[b] HIV-estimated PCP divided by PCP discharges multiplied by 100.

[c] Background considered 82.5 percent reported (78 PCP discharges).

and another, 795.8, indicates an HIV-seropositive test result. The purpose of this study was to estimate the completeness with which admissions of HIV-infected patients were identified in the SPARCS.

Methods

We studied the completeness of HIV identification in admissions for *Pneumocystis carinii* pneumonia (PCP) in SPARCS during 1987 and 1988. PCP was extremely rare prior to the HIV epidemic[4–6]; it is now the most frequently found illness in persons with acquired immunodeficiency syndrome (AIDS).[7] Each SPARCS discharge record with a diagnosis of PCP infection (ICD-9-CM code 136.3 in the principal or secondary diagnosis fields) was considered to represent a PCP admission. Each PCP discharge with an ICD-9-CM code of 042-044 or 795.8 in the principal or secondary diagnosis fields was considered to be a PCP admission identified with HIV infection.

To establish the expected number of HIV-related PCP discharges in the given year, we subtracted the estimated number of non-HIV not-related PCP discharges from the reported number. We estimated this "background" frequency of non-HIV-related PCP discharges by counting the number of PCP discharges in 1980; we assumed such discharges to be non-HIV related. We assumed the number non-HIV-related PCP discharges had not substantially changed since 1980.

We studied the validity of the assumption that the annual number of non-HIV-related PCP discharges remained essentially unchanged in two ways. First, we compared the 1987 and 1980 PCP admissions from New York State counties that reported fewer than two AIDS cases through 1987 to the New York State AIDS Registry. If our assumption was correct, there should have been little or no difference in the number of PCP discharges by these counties in the 2 years.

Second, we reviewed the extent of HIV identification in PCP discharges in the "most sensitive" hospitals, those with the most experience with PCP in 1988. If our assumption was correct, the number of non-HIV-identified PCP discharges in such hospitals should be consistent with our 1980 background estimate.

We also investigated whether the percentage of PCP discharge abstracts with an ICD-9-CM code indicating HIV infection was associated with a hospital's experience with PCP. Hospitals were grouped into 11 different experience levels for each year studied. Linear regression using SAS[8] was performed to determine if a relation existed between PCP experience, year, and HIV coding.

TABLE 2—HIV Associated with PCP Discharges in 1987 and 1988

PCP Discharges Per Hospital	1987: Ratio of PCP Discharges with HIV Identified to PCP Discharges (%)	1988: Ratio of PCP Discharges with HIV Identified to PCP Discharges (%)
1–10	248/389 (64)	283/368 (77)
11–20	236/29[illegible] (79)	174/202 (86)
21–30	236/267 (88)	233/269 (87)
31-40	129/169 (76)	183/210 (87)
41–50	147/181 (81)	113/131 (86)
51–60	39/52 (75)	156/162 (96)
61–70	224/267 (84)	233/254 (92)
71–80	131/148 (89)	116/142 (82)
81–90	67/83 (81)	62/81 (77)
91–100	250/289 (87)	87/99 (88)
>100	3184/3582(89)	2869/3175(90)

Note: Data obtained from the New York State Statewide Planning and Research Cooperative System (SPARCS). Data for 1988 are 80–85 percent complete.

Results

Completeness of HIV-Infection Identification

Non-HIV-related PCP Rates—In 1980, 94 discharges with a PCP diagnosis were reported to SPARCS. At that rate, one would expect non-HIV PCP background level of 1.6 percent in 1987 and 1988.

Eight of the 62 counties in New York State reported fewer than two AIDS cases to the New York State Registry through 1987. In 1980 each of these eight counties reported no PCP discharges. In 1987, four of the[se] eight counties reported no PCP discharges, three reported one PCP discharge, and one reported two PCP discharges.

Our review of the two hospitals with the largest number of PCP discharges (277 and 241) in 1988 revealed that HIV was associated with 97.4 percent and 99.6 percent of the PCP discharges.

PCP Discharges and HIV Codes—The results are shown in Table 1. After correction is made using the non-HIV PCP background, 98 percent of PCP discharge records in 1987 and 1988 should have been identified with an HIV diagnosis. Only 87 percent of the 1987 PCP discharge records and 90 percent of the 1988 records included an HIV diagnosis. Thus, up to 13 percent more of the 1987 and 10 percent more of the 1988 PCP discharge records should have contained an HIV-infection code.

Hospital Experience

Two linear regression models were considered. The first included year and hospital PCP volume as independent variables and percentage HIV identified as the dependent variable. A borderline significant effect was noted for year ($\beta = 5.00$, SE = 2.63, $p = .07$). Utilizing the data available from both years, a reduced model was then considered that contained only hospital PCP volume as the independent variable (Table 2). Results from that model indicated a positive association between hospital PCP volume and percentage HIV identified ($\beta = 0.93$, SE = 0.45, $p = .049$).

Discussion

After correcting for the non-HIV-related PCP discharges, we have found undercoding of HIV infection in discharge abstracts of PCP-identified patients in New York State's acute care facilities. The amount of undercoding was a function of the facility's volume of PCP patients.

Our estimate of HIV-related PCP discharges depended on our assumption that the number of non-HIV-related PCP discharges was essentially constant statewide between 1980 and 1988. The results from our review of PCP occurrence in counties with a low incidence of AIDS and in hospitals with a high occurrence of PCP are consistent with such an assumption. However, there may be secular trends in non-HIV-related causes of PCP that affect the background level. Review of diagnoses in the SPARCS records of non-HIV-identified PCP patients is not sufficient to determine the presence or absence of HIV infection.

The reasons for the hospital variations in reporting PCP patients as HIV infected are unknown. In the interest of confidentiality, a hospital may choose to report that a patient was not HIV-positive even though the condition was diagnosed or suspected. A lack of sufficient number of diagnostic fields in SPARCS may also be a factor, since many PCP patients are sufficiently ill with other conditions that could fill the principal and four secondary diagnosis fields of the SPARCS record. However, since the inclusion of an HIV diagnostic code would increase reimbursement substantially, HIV coding should take precedence by hospitals when its presence is known.

Another explanation is that even at this late date in the HIV epidemic, providers in New York State do not recognize that PCP patients demonstrate the most publicized HIV-related opportunistic infection. If so, other, more subtle sequelae of HIV infection may be being identified at an even lower rate, and treatment of HIV-infected patients may be delayed. Further study of the non-HIV-infected PCP patients would clearly be fruitful. In the absence of such a study, it is prudent to recognize that statewide HIV hospitalization utilization may be underestimated when SPARCS or a comparable system is used as the source. ☐

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Survival Trends of People with AIDS in Washington State

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ABSTRACT

Survival rates of 609 cases of acquired immunodeficiency syndrome (AIDS) in Washington State diagnosed between 1982 and 1987 according to pre-1987 AIDS surveillance definition were analyzed. People with a primary diagnosis of Kaposi's sarcoma survived longer than those with *Pneumocystis carinii* pneumonia. Both groups survived longer than those with other diagnoses. Median survival increased from 11.3, to 12.5, to 20.8 months for cases diagnosed in or before 1985, during 1986, and during 1987, respectively. (*Am J Public Health* 1991; 81:215–218)

Introduction

In Seattle–King County, the major metropolitan area in Washington State, acquired immunodeficiency syndrome (AIDS) was the third leading cause of death in males aged 25–44 years in 1986. In 1987, it was second, according to the King County Department of Vital Statistics. While AIDS continues to increase in importance as a cause of mortality,[1] therapeutic advances should eventually be reflected in decreased mortality and longer survival times. Such trends have been reported from major epicenters of the epidemic, such as San Francisco,[2] and may be occurring nationwide.[3] Our study confirms that survival times of persons living

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TABLE 1—Demographic Characteristics of AIDS Cases, by Year of Diagnosis

Year of Diagnosis	N[a]	Mean ± SD Age (Years)	% Male	% White	% Gay	% Gay/ IVDU	% IVDU	Other Risk
≤1985	185	37.4±8.9	98	92	84	11	1	5
1986	181	36.7±9.3	98	90	82	6	2	6
1987	243	36.2±8.7	98	92	83	10	3	4

[a] Excludes 21 cases before 1986, 25 cases in 1986, and 25 cases in 1987 that died within 1 month of diagnosis.
Note: $p > .3$ for all comparisons of characteristics over time. IVDU = intravenous drug use.

TABLE 2—Median Survival (months) of People with AIDS in Washington State, by Disease

	Total		PCP		KS		Other Diseases	
Year of Diagnosis	N[a]	Months	N	Months	N	Months	N	Months
≤1985	185	11.3	105	12.3	34	12.4	46	7.7
1986	181	12.5	98	14.1	55	18.7	28	7.6
1987	243	20.8	137	20.8	69	—	37	14.9

[a] Excludes 21 cases before 1986, 25 cases in 1986, and 25 cases in 1987 that died within 1 month of diagnosis.

with AIDS have increased in Washington State independent of changes in the AIDS case definition.

Methods

The Washington State and Seattle-King County human immunodeficiency virus (HIV)–AIDS epidemiology units maintain [a] registry of case reports that meet the Centers for Disease Control (CDC) surveillance definition of AIDS. All resident cases were investigated. Survival analysis was performed only for patients 13 years of age or older that met the pre-1987 case definition.[4] Cases with more than one primary diagnosis were classified by hierarchy into one of three categories: *Pneumocystis carinii* pneumonia (PCP), other diagnosis without PCP, or Kaposi's sarcoma (KS) alone. Passive AIDS case reporting was estimated to be 96 percent and 88 percent complete in 1986 and 1988, respectively, according to methods previously described.[5]

In December 1988 all presumed surviving cases diagnosed on or before December 1987 were investigated. Provider contact and telephone surveillance are routine and update mortality status yearly. County vital records were reviewed for recent deaths that were either unknown to providers or may not have reached the state's vital records office. County vital records yielded 10 unreported deaths among 286 persons with AIDS who were presumed living after provider contact. Three cases lost to follow-up were censored at the last date known to be alive.

Cohorts were formed of individuals diagnosed in 1985 or before, individuals diagnosed in 1986, and individuals diagnosed in 1987. The groups were compared by means of nonparametric rank tests for censored data[6] after adjusting for primary diagnosis but not for any other prognostic variables. The effect of year and diagnosis was also estimated by fitting the Cox proportional hazards model. Hazard comparisons are relative to cases diagnosed before 1986 with KS and were made using BMDP2L.[7] Because of the limited amount of data available on any given subject, our ability to investigate and adjust for prognostic variables was limited.

The CDC case report forms record the month and year in which an individual is diagnosed and the day, month, and year of death. Approximate survival times were constructed by assuming that all individuals were diagnosed on the 15th of the month. For the generalized Wilcoxin test this is equivalent to breaking tied death times (tied if counted in months) in favor of individuals who died later in the month. These approximate death times were also used to produce Kaplan-Meier survival curves using PROC Lifetest[8] and to produce the relative hazard estimates.

Results

Through the end of 1987, 777 adult AIDS cases had been reported; 680 met the pre-1987 AIDS case definition. Seventy-one of these cases died within 1 month of diagnosis. Mean age at the time of diagnosis, racial composition, sex, and transmission category of the three temporal cohorts did not change significantly between the intervals (Table 1). Although the proportion of intravenous drug users (IVDUs) increased from 1 percent to 3

TABLE 3—Relative Hazard Table of Cohort Survival

Data	Relative Hazard	95% CI
Primary diagnosis		
KS	1.00	—
PCP	1.46	1.22, 1.91
Other diagnosis	2.20	1.63, 2.96
Year of diagnosis		
≤1985	1.00	—
1986	0.68	.545, .852
1987	0.39	.304, .497

percent from 1985 to 1987, only 12 IVDUs were included in the study. Overall, the proportion of cases diagnosed as outpatients increased from 11 percent to 20 percent between 1985 and 1987. Of definitively diagnosed cases of KS, 19 percent, 26 percent, and 68 percent were diagnosed as outpatients before 1986, in 1986, and in 1987, respectively (data not shown).

Overall, cases survived a median of 14.4 months (Tables 2 and 3). People with KS survived longer than people with PCP. Both groups survived longer than those with other diagnoses. Survival increased in cases diagnosed in more recent years. Cases of PCP and other diagnoses that were diagnosed during 1989 had longer survival times than those diagnosed in 1986 ($p < .001$, for each comparison). Most people with KS diagnosed in 1987 were still living. Median survival for inpatient cases with primary diagnoses of PCP increased from 12.4, to 15.8, to 20.8 months for the three time intervals, respectively ($p < .0001$).

Discussion

We believe our ascertainment of deaths was fairly complete. Although recent out-of-state deaths could have been missed by these methods, the impact of these cases would be 5 percent or less. In addition, since completion of this study, cases have been matched to the National Death Index. Only two deaths were detected that were not included in this analysis.

Our data confirm that trends seen in major epicenters of the AIDS epidemic are occurring elsewhere in the United States. Increases in survival for people with primary diagnoses of PCP could be related to PCP prophylaxis and zidovudine therapy. Local zidovudine studies treated approximately 52 residents who had PCP diagnosed in 1986. The lack of increase in the median survival of people with other diagnoses from 1985 to 1986 may reflect their ineligibility for zidovudine studies.

Although studies in San Francisco have shown a decrease in median survival for people with KS through 1985 and slight increases during 1986 and 1987,[2] our KS cohort diagnosed in 1986 survived longer than those diagnosed during or before 1985. The increase in outpatient diagnoses of KS from 1985 to 1987, from 19 percent to 68 percent, suggests this practice may in part be responsible for our local data. The general availability of zidovudine in March 1987 may be responsible in part for the sharp increases in survival seen in 1987. Exclusion of outpatient diagnoses for people with PCP did not reduce median survival; therefore, earlier diagnosis is an unlikely reason for prolonged survival in this cohort.

The impact of prolonged survival of people living with AIDS on the health care system needs evaluation. Although CDC case projections for 1990 and beyond have been reduced in cumulative numbers by 16 percent through 1993,[9] increased survival may neutralize the effect of fewer new cases on the health care system. Recent federal registration (H.R. 2310) expanding insurance continuation from 18 to 29 months may make health care more accessible to a larger number of people living with AIDS who survive longer than 18 months. However as the use of zidovudine and other antiviral drugs prolongs survival, health care programs need to provide long-term access to people who are otherwise uninsurable. □

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New from NCHS

Long-term Care for the Functionally Dependent Elderly

Introduction

Greater attention has focused recently on financing of long-term care, due both to the growing burden to society and individuals and to the increasing size of the elderly population at risk of needing long-term care. As a result, insurance companies underwriting private long-term care insurance policies, legislators, and other policy makers need estimates of the population most at risk of needing long-term care. A recent report from the National Center for Health Statistics (NCHS) should help such policy makers plan for long-term care services.[1]

The report was based on combined data from the Supplement on Aging (SOA) to the 1984 National Health Interview Survey (NHIS) and the 1985 National Nursing Home Survey (NNHS). In brief, the NHIS is a continuing national survey of the health of people residing in households in the United States. The SOA was added in 1984 to obtain information about older persons that had not been available previously from a national survey. All persons age 65 years and over and half of those ages 55–64 in responding NHIS households were included in the SOA sample; 97 percent of those eligible participated in the SOA (16,148 people) of whom 92 percent responded for themselves. Descriptions of the NHIS and SOA have been published.[2,3]

Data on nursing home residents are from the 1985 NNHS, a national probability sample of nursing homes, their residents, discharges, and staff. Homes included in the NNHS were nursing and related care homes in the conterminous United States, without regard to the level of care, whether they participated in Medicare or Medicaid, or whether they were licensed. Board and care homes and residential care homes were excluded.

Nursing home resident estimates are based on the sample of 4,650 residents ages 65 years and over from the 1,079 nursing homes participating in the survey. Residents included in the sample were those on the nursing home's roster as of the night before survey. Data were collected by interviewing knowledgeable nursing home staff members, who referred to the residents' medical records when necessary. The response rate for the resident sample was 97 percent.[4]

The report profiles long-term care use by functionally dependent people age 65 years and over, where functionally dependent is defined as receiving human assistance with at least one activity of daily living (ADL) or instrumental activity of daily living (IADL). Persons who did not perform or were unable to perform the activity were also considered dependent. ADLs are the basic personal functions of bathing, dressing, eating, getting in or out of a bed or chair, mobility, using the toilet, and continence. IADLs are everyday activities that enable an individual to live independently in the community: preparing meals, shopping, managing money, using the telephone, doing light or heavy housework, and getting around outside the home.

Criteria used to define dependence in the ADLs and IADLs for noninstitutionalized people were largely based on those used in an earlier report on the physical functioning of the aged.[5]

Noninstitutionalized Elderly

Dependence in the ADLs for noninstitutionalized people was defined as: 1) having difficulty performing the activity because of a chronic condition and *receiving* help of another person in performing the activity; or 2) being unable to perform the activity without special equipment and not having that equipment. Dependence in the IADLs for this population was defined as having difficulty or inability to perform the activity without assistance because of a health problem.

Institutionalized Elderly

On the other hand, dependence in the ADLs for nursing home residents was defined as requiring (needing) assistance of another person or special equipment to perform the activity. Dependence in the IADLs for nursing home residents was defined as receiving personal help or supervision to perform the activity. For the purposes of this report, it was assumed that the effect of differences in question wording between the SOA and the NNHS ("receiving" versus "needing" help) was minimal because residents in an institutional environment are likely to receive assistance if they need it. It was also assumed that all nursing home residents were dependent in two IADL activities (preparing meals and doing heavy housework) routinely provided in nursing homes, even though not all residents were dependent in these activities.

Results

Based on combined estimates of the institutionalized and noninstitutionalized population of the United States, 29 percent of people age 65 years and over in

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TABLE 1—Number and percent of functionally dependent people age 65 years and over by level of ADL or IADL dependency and type of long-term care received, United States, 1984–85

Level of ADL or IADL Dependency and Type of Long-term Care Received	Number	Percent of Persons aged 65 Years and over	Percent of Functionally Dependent
All persons 65 years and over	27,751,300	100.0	—
Level of ADL or IADL dependency			
All functionally dependent elderly	8,051,100	29.0	100.0
5–7 ADL dependencies	1,373,800	5.0	17.1
3–4 ADL dependencies	728,000	2.6	9.0
1–2 ADL dependencies	3,968,600	14.3	49.3
IADL dependencies only	1,980,700	7.1	24.6
Type of long-term care received by functionally dependent elderly			
All functionally dependent elderly	8,051,100	29.0	100.0
Nursing home care	1,318,300	4.8	16.4
Formal home care[a]	1,662,500	6.0	20.6
Informal home care only	3,380,400	12.2	42.0
No long-term care	1,689,800	6.1	21.0

a) Includes persons receiving both formal and informal home care services.
ADL = activities of daily living
IADL = instrumental activities of daily living.

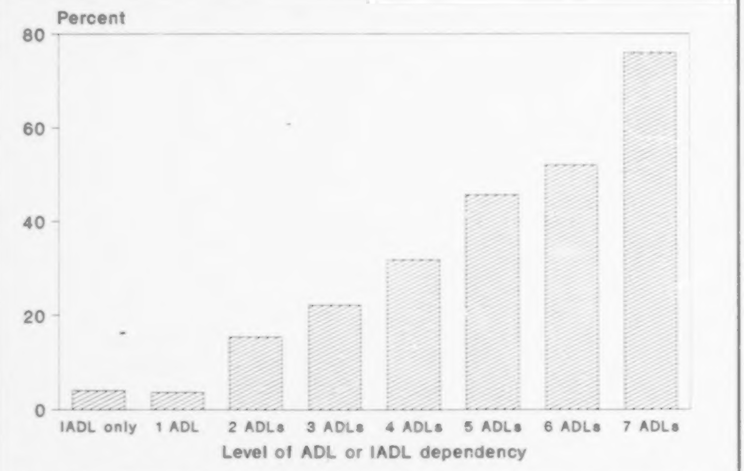

FIGURE 1—Percent of functionally dependent persons age 65 years and over residing in nursing homes by level of ADL or IADL dependency: United States, 1984–85

1984–85, or 8 million persons, were functionally dependent and at risk of needing long-term care services. About three-fourths of this population had only slight limitations in these functions; 49 percent were dependent in only one or two ADLs and 25 percent were dependent in only the IADLs. About 9 percent were moderately dependent, receiving assistance in three to four ADLs, while 17 percent were severely dependent, receiving assistance in nearly all ADLs and IADLs.

Although long-term care has traditionally meant nursing homes, it also includes the services of home health agencies, visiting nurses, adult day care centers and other community-based services, as well as care provided informally by family and friends. This report examined three types of long-term care: nursing home care, formal home care, and informal home care. Formal home care services were defined as receipt of paid-for personal assistance in performing at least one ADL or IADL, while help provided without compensation was considered informal home care. In 1984–85, 79 percent of the functionally dependent elderly population received long-term care services (Table 1). Informal home care by family and friends was the most commonly received type of long-term care (42 percent). About 21 percent received formal home care services, often in combination with informal home care. About 16 percent of the functionally dependent elderly resided in nursing homes. The percent of functionally dependent elderly persons receiving these three types of long-term care is much higher than that for the general elderly population. In 1984–85, the percent of elderly receiving informal home care was 12 percent, while 6 percent received at least some formal home care service. Only 5 percent of the elderly resided in nursing homes (Table 1).

The degree of dependency in the ADLs and IADLs was associated with the type of long-term care used by functionally dependent persons. Home care use was greater among those with only IADL limitations or four or fewer ADL limitations; nursing home use was greatest among those dependent in five to seven ADLs. There was a nearly linear relationship between the percent of functionally dependent elderly residing in nursing homes and the number of ADL dependencies. About 76 percent of the elderly dependent in all ADL functions were in nursing homes compared with 4 percent of the elderly dependent in only one ADL function (Figure 1). This finding, however, is affected by the fact that many nursing homes have policies that do not permit a resident to perform the ADLs or IADLs without assistance.

Because functional dependency in ADL and IADL activities is higher at older ages (from 20 percent among those ages 65–74 years to 66 percent among those ages 85 years and over), overall use of long-term care, and use of nursing homes in particular, was also higher at older ages. The percent of functionally dependent elderly using long-term care increased from 71 percent among those ages 65–74 years to 93 percent of those ages 85 years and over; nursing home use increased from 6 percent among those ages 65–74 years to 36 percent among those age 85 years and over. The average age of functionally dependent elderly in nursing homes was 83 years, while that of their counterparts using any formal or only informal home care services was 78 and 77 years, respectively. Besides age, other

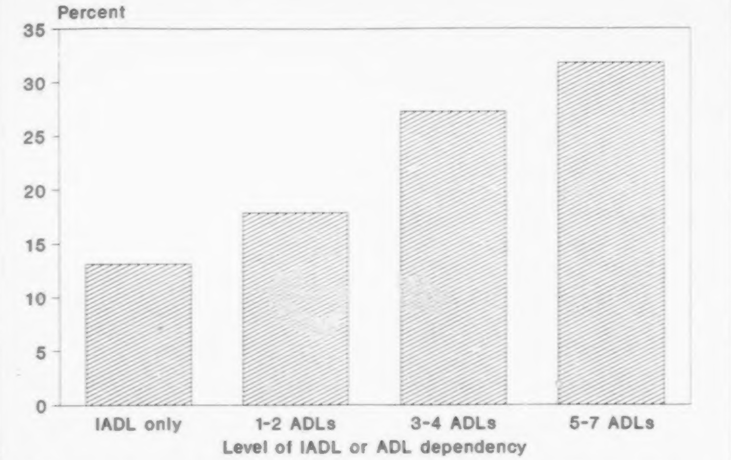

FIGURE 2—Percent of functionally dependent home care recipients receiving both formal and informal home care services: United States, 1984–85

factors found to be significantly associated with nursing home use were being female, White race, being unmarried, and having income below the poverty threshold.

Home care services (formal or informal) were used by a younger, less dependent population. Availability of an informal support network of family and friends appears to be associated with receipt of informal care; among the functionally dependent elderly, use of informal home care services was greater for males, for persons living with a spouse or others, and for married persons; use of any formal home care services was greater for females, for persons living alone, and for unmarried persons. The greater use of informal home care services by Black functionally dependent elderly coincides with their greater likelihood of living with spouse or others (potential caregivers). Functionally dependent elderly persons with income above the poverty threshold were more likely to use both formal and informal home care services.

Use of formal home care services, however, was also dependent on the level of ADL or IADL limitations. Formal home care services were used to augment informal care provided by family or friends more often among the severely dependent elderly than among those with few limitations. Thirty-two percent of home care recipients dependent in five to seven ADLs, and 27 percent of the elderly home care recipients dependent in three to four ADLs relied on both formal and informal caregivers, compared with 13 percent of home care recipients dependent in only the IADLs (Figure 2). Persons living alone were four to five times more likely to use only formal home care services than those living with spouse or others; persons living with spouse or others were more likely to receive only informal home care services.

Discussion

While this report presents a more complete picture of long-term care use by the functionally dependent elderly population than available by looking at only the nursing home or the community-dwelling population, the data have limitations in interpretation. First, there are reporting differences in the SOA and NNHS data; the surveys had different respondents (self-report versus nursing home staff), and the question wording was not always identical. Second, the two surveys were fielded in different years. This problem, however, should be negligible since the proportion of the noninstitutionalized population that was functionally dependent did not change between 1984 and 1986. Further research is possible by accessing public use data tapes for the 1984 SOA and the 1985 NNHS. The 1984 SOA can be obtained from the Division of Health Interview Statistics, National Center for Health Statistics in Hyattsville, Maryland. The 1985 NNHS can be obtained from the National Technical Information Service in Springfield, Virginia. Both data tapes are also available from the National Archive of Computerized Data on Aging (NACDA) from the Inter-university Consortium for Political and Social Research at the University of Michigan in Ann Arbor, Michigan. ☐

Esther Hing, BS
Barbara Bloom, MPA

Copies of the report, *Long-term Care for the Functionally Dependent Elderly*, by Hing and Bloom, *Vital Health Stat* 13 (104) can be purchased from the US Government Printing Office, Washington, DC 20402. Order stock no. 017-022-01116-6. The price is $3.00.

For more information about this and other reports and data from the National Center for Health Statistics, write to the Scientific and Technical Information Branch, NCHS, 6525 Belcrest Road, Hyattsville, MD 20782, or call (301) 436-8500.

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Impact of the Minnesota Parental Notification Law on Abortion and Birth

ABSTRACT

Background. The impact of the Minnesota Parental Notification Law on abortion and birth was examined.

Methods. Using linear models, outcome parameters were compared before and after enactment of the law. Time by age group interactions also were examined.

Results. The pre-enactment to post-enactment change in the Minnesota abortion rate reflected a greater decline for minors (≤17 years old) than for 18–19 year-olds (who were not under the law). An increase in abortion rate occurred for women ages 20–44. The law appeared to have had no impact on birth rate in minors. Following the enactment of the law, the rate of early abortions (≤12 weeks) declined among minors more than the rate of late abortions (>12 weeks). This resulted in a pre-enactment to post-enactment increase in the ratio of late-to-early abortions among minors.

Conclusions. These data suggest that parental notification facilitated pregnancy avoidance in 15–17 year-old Minnesota women. Abortion rates declined unexpectedly while birth rates continued to decline in accordance with a long-term trend. (*Am J Public Health* 1991;81:294–298)

James L. Rogers, PhD, Robert F. Boruch, PhD, George B. Stoms, BA, and Dorothy DeMoya, DNSc

Introduction

Laws requiring parental consent or parental notification prior to legal induced abortion for minor women, collectively called parental involvement laws, exist or have been proposed in numerous states. As of July 1990, laws in the United States requiring parental consent were in effect in Alabama, Indiana, Louisiana, Massachusetts, Missouri, North Dakota, and Rhode Island. Laws requiring parental notice were in effect in Arkansas, Idaho, Utah, and West Virginia; and parental involvement statutes were under challenge in Arizona, California, Georgia, Illinois, Kentucky, Mississippi, Nevada, Pennsylvania, and Tennessee. National attention focused on these laws when statutes from Minnesota and Ohio were heard by the US Supreme Court during its October 1989 term resulting in a decision largely supporting these laws. The present paper concerns the Minnesota law, enacted in August 1981 and enjoined in March 1986. This law required a minor woman to notify both parents at least 48 hours prior to an abortion or else seek court approval.

Few empirical studies have evaluated the impact of parental involvement statutes on minor women. Cartoof and Klerman[1] determined that abortions to minors in Massachusetts declined dramatically (43 percent) following the enactment of a parental consent law. However, during this time an approximately equal number of women migrated to surrounding states to obtain abortions. Blum[2] found that under parental notification in Minnesota, communication with parents about a minor's planned abortion occurred more often than had been reported by Clary[3] in a Minneapolis/St. Paul study predating the law. But Blum found that patterns of communication differed little from those among teenagers simultaneously surveyed in the neighboring state of Wisconsin (without such a law).

Common negative claims about parental involvement laws are that they force minors to leave the state to obtain abortions (as in Massachusetts), and that they result in increased birth rates, late abortions and medical complications. These effects are presumably related to a minor's reluctance to discuss her pregnancy with parents.[4] Positive claims about these laws are that they promote responsibility (by encouraging teenagers to "think before they act"), foster parent-child communication, facilitate mature decision making, and may reveal medical history information that would otherwise remain unknown to the physician.[5,6]

Empirical evaluation of assertions like these will necessitate multiple studies under a variety of circumstances and localities. The Cartoof and Klerman study[1] was conducted in Massachusetts, located in close proximity to states without parental involvement laws. This made it possible for minors to avoid the law altogether by crossing state lines. In Minnesota, the distance from out-of-state abortion facilities appears to have worked against mi-

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gration. Blum determined that "[i]n counterdistinction to the Massachusetts data, there is little evidence to indicate large numbers of Minnesota youths are leaving the state for abortion (data available on request to author)."[2] It cannot be assumed that findings characterized by one set of background factors, such as proximity to out-of-state abortion facilities, will generalize to other settings.

In this study, the statewide impact of the Minnesota Parental Notification Law upon the incidence rate of abortion and birth, as well as upon the ratio of abortions to births and the ratio of early to late abortions, is examined.

Methods

Data

Abortion and birth incidence data were provided by the Minnesota Center for Health Statistics (MCHS). The data exclude all observations of unknown age and are restricted to residents of Minnesota. Live births to Minnesota residents are included regardless of whether the birth occurred inside or outside of Minnesota. Induced abortions reflect only those occurring in Minnesota.

Population estimates by age and gender are provided by the Minnesota Center for Health Statistics that computed them using a modified version of the cohort-component method for all years following the 1980 census.[7]

Throughout this report "birth(s)" and "abortion(s)" will refer to live birth(s) and induced abortions(s), respectively.

Outcome Measurements

The report utilizes six outcome measurements: four rates and two ratios.

- The abortion rate, the late abortion rate (>12 weeks), the early abortion rate (≤12 weeks) and the birth rate refer to the number of reported abortions (or births) in one year divided by the population estimate of females, in thousands, for that same year.
- The abortion-to-birth ratio refers to the number of abortions in a year divided by the number of births. Alternatively, this may be thought of as the abortion rate divided by the birth rate for a given year.
- The late-to-early abortion ratio refers to the number of late abortions in a year divided by the number of early abortions. Again, this may be thought of as the late abortion rate divided by the early abortion rate for a given year.

Measures of Effect

Each rate and ratio was examined using a linear model.[8,9] Serving as a dependent variable, the rate (or ratio) was modeled as a function of age category (≤17, 18–19 or 20–44 years old), the year of occurrence (1975 through 1987), and the age by year interaction.

First, each model was employed to determine whether a given rate (or ratio) three years before and four years after enactment of the Minnesota Parental Notification Law differed within each age category. Because the modeling was performed in the log scale, the pre-enactment (1978 to 1980) and post-enactment (1982 to 1985) values represent the geometric mean of the individual values comprising the pre-enactment and post-enactment periods. (The antilog of the arithmetic mean of log values corresponds to the geometric mean of the same measurement in the original scale. That is, anti-$\ln [\ln a + \ln b]/2 = \sqrt{[ab]}$.)

Second, three additional contrasts were constructed to detect the presence of any age group by time interaction that might exist for a given rate or ratio. These contrasts reflect whether the pre-enactment to post-enactment *change* was different among minors than among 18–19 year-olds, or 20–44 year-olds, or among 18–19 year-olds than women 20–44 years old. It was assumed that a change due to the law, rather than to general factors operating in all age groups, would be most pronounced among women 17 years of age or younger; less evident among 18 and 19 year-old women who would have recently been, but would not presently be under the law (pregnancy at age 17 may mean birth at age 18); and least present among older women not subject to the law for at least two years.

Models

The mechanics underlying the linear models[8,9] used to construct the six contrasts described above were as follows. The model parameters, representing age category (two parameters capturing three age classifications), year (12 parameters capturing 13 years), and the age by year interaction (24 parameters reflecting the cross-product of age and year), were regressed against the ***natural log*** of the rate or ratio under question. Rows of each model's design matrix were combined to form the six contrasts. When the abortion rate, late abortion rate, early abortion rate, or birth rate served as the dependent variable, weighted least squares estimates and asymptotic variances for the estimates were obtained. When the abortion-to-birth ratio or late-to-early abortion ratio served as the dependent variable, maximum likelihood was used to obtain estimates and asymptotic variances. PROC CATMOD of Version 6.03 of the Statistical Analysis Software (SAS)[10] was employed to fit the models.

For ease of interpretation, the authors elected to display each contrast effect as a quotient (contrast ratio) in the original scale rather than a difference in the log scale. For any given contrast, this means that rather than presenting in tables the difference between two natural log values, it is the antilog of this difference that has been presented. It is evident that the difference between two identical log values will be "zero" while the corresponding contrast ratio will be unity (one). That is, $(\ln A) - (\ln A) = 0$ implies that the antilog is unity. Thus, contrast ratios equal to unity imply equivalence between the contrasted values.

Results

Table 1 contains the outcome measures examined in this study. For each outcome measure, Table 2 contains the contrast ratios that compare the pre-enactment and post-enactment periods. Contrast ratios greater than unity imply an increase in the outcome measure (abortion rate, birth rate, etc.) after enactment of the law and contrast ratios less than unity imply a decrease. Similarly, Table 3 contains ratios that reflect the age by time interactions. Here, a contrast ratio less than unity indicates a greater pre-enactment to post-enactment decline in the younger age group of the two being compared; a contrast ratio greater than unity indicates a greater increase.

Abortion Rate

Deviations from unity for the contrast ratios that compare pre-enactment and post-enactment periods (Table 2) are substantial in all age groups. Whereas the yearly abortion rates after the law's enactment increased for women 20–44 years old (who were substantially removed from its impact), abortion rates declined in both 15–17 and 18–19 year-olds during this same period. The pre-enactment to post-enactment decline was substantially greater for 15–17 than 18–19 year-old women, and for 18–19 year-old women than 20–44 year-old women (Table 3).

TABLE 1—Outcome Measures and Population Estimates for Minnesota Women, 1975 to 1987[*]

Outcome Measure	Age (years)	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Abortion Rate[†]	15–17	12.38	16.50	18.60	18.25	19.24	19.57	16.06	14.25	12.80	13.03	14.54	14.42	15.45
	18–19	20.47	28.92	31.27	35.71	38.72	40.26	38.37	36.45	33.08	35.05	34.07	31.89	30.83
	20–44	7.32	9.55	11.48	12.36	13.41	14.13	14.00	13.96	13.11	14.21	14.48	14.29	14.17
Birth Rate[†]	15–17	20.94	19.64	19.62	17.80	17.71	17.48	17.36	16.54	14.56	16.00	15.01	15.52	15.03
	18–19	56.11	52.96	55.10	55.60	57.00	59.48	59.33	56.57	48.76	48.85	47.18	42.65	43.68
	20–44	74.02	72.48	75.79	76.14	78.05	79.80	79.43	78.13	75.18	75.57	75.92	74.00	72.67
Abortions/ Births	15–17	0.59	0.84	0.95	1.03	1.09	1.12	0.93	0.86	0.88	0.81	0.97	0.93	1.03
	18–19	0.36	0.55	0.57	0.64	0.68	0.68	0.65	0.64	0.68	0.72	0.72	0.75	0.71
	20–44	0.10	0.13	0.15	0.16	0.17	0.18	0.18	0.18	0.17	0.19	0.19	0.19	0.19
Early Abortion Rate[†]	15–17	10.22	12.81	14.73	14.97	15.73	15.34	12.93	11.37	9.86	9.68	11.24	11.38	12.65
	18–19	17.81	24.01	25.89	30.46	33.31	33.56	32.58	30.92	27.63	28.42	28.13	26.04	26.23
	20–44	6.62	8.45	10.23	11.24	12.19	12.71	12.74	12.65	11.87	12.69	13.04	12.85	12.84
Late Abortion Rate[†]	15–17	2.16	3.69	3.88	3.28	3.51	4.23	3.13	2.89	2.94	3.36	3.30	3.04	2.80
	18–19	2.65	4.91	5.39	5.25	5.41	6.69	5.78	5.53	5.44	6.63	5.94	5.85	4.56
	20–44	0.70	1.10	1.25	1.11	1.23	1.42	1.27	1.31	1.24	1.53	1.44	1.44	1.31
Late/Early Abortions	15–17	0.21	0.29	0.26	0.22	0.22	0.28	0.24	0.25	0.30	0.35	0.29	0.27	0.22
	18–19	0.15	0.20	0.21	0.17	0.16	0.20	0.16	0.18	0.20	0.23	0.21	0.22	0.17
	20–44	0.11	0.13	0.12	0.10	0.10	0.11	0.10	0.10	0.10	0.12	0.11	0.11	0.10
Population	15–17	115684	117102	116317	115722	115262	113600	108143	103981	104371	100131	100912	101172	101846
	18–19	85889	86826	86110	85525	85047	83964	79863	76786	77004	73784	74295	74375	74788
	20–44	662309	683069	700327	722162	747058	761209	779081	797138	799912	811693	819042	821954	828167

[*] Raw data provided by the Minnesota Center for Health Statistics.
[†] Abortion, birth, early abortion and late abortion rates are expressed as the number of abortions or births per 1000 women.
NOTE: Early abortions: ≤12 weeks; Late abortions: >12 weeks.

Birth Rate

Birth rates decreased in all age categories following enactment of the law (Table 2). However, the decline was most pronounced in 15–17 and 18–19 year-old women. Table 3 reveals that the pre-enactment to post-enactment change among 15–17 and 18–19 year-old women was similar, with both age groups evidencing a substantially greater decline than found among women ages 20–44.

Ratio of Abortions to Births

A marked drop in the abortion-to-birth ratio occurred after the law in 15–17 year-old women when compared to both 18–19 year-old women and 20–44 year-old women (see Tables 2 and 3). In Figure 1, the abortion rate and birth rate are plotted separately for 15–17 year-old women along with the abortion-to-birth ratio (abortion rate/birth rate) in order to examine the relative importance of abortions and births to the markedly declining abortion-to-birth ratio in this age group. It is evident that birth rates continue a modest and nearly linear decline, apparently unaffected by the law (r = −0.89 between birth rate and year). On the other hand, the abortion rate falls dramatically after the enactment of the law in August 1981. Together, these facts indicate that the drop in the 15–17 year-old abortion-to-birth ratio is due to a disproportionately greater decrease in the abortion rate (numerator).

Early and Late Abortions

The early abortion rate closely tracks the overall abortion rate (Tables 2 and 3). The pre-enactment to post-enactment late abortion rate substantially declines for women of 15–17 years, increases for women of 20–44 years, and remains nearly constant for women of 18–19 years (Table 2). The pre-enactment to post-enactment change in the late abortion rate, when compared between age groups, evidences a greater decline in late abortions for 15–17 than for either 18–19 or 20–44 year-old women (Table 3).

The late-to-early abortion ratio increased after the enactment of the law in all age groups (Table 2). However, the increase was greater among 15–17 year-old women than 20–44 year-old women (Table 3). Figure 2 reveals that a steep decline in early abortions, not an increase in late abortions, accounts for the increased late-to-early abortion ratio ~~in~~ 15–17 year-old women.

Discussion

Data presented in this study are compatible with the hypothesis that, initially, parental notification facilitated pregnancy avoidance in 15–17 year-old Minnesota women. Abortion rates fell markedly in this age group relative to older women. Birth rates also fell, but only in keeping with a long-term trend established before enactment of the law. One possibility is that when minor women are restricted from abortion without notifying parents or seeking court approval, and are geographically prohibited from easy access to out-of-state abortions,[2] they are more likely to take measures to avoid pregnancy.

Although the data are compatible with this hypothesis, other explanations are possible. For example, a growing concern over human immunodeficiency virus infection, and/or awareness and availability of birth control may explain in part or in full these findings. However,

TABLE 2—Contrasts Between Pre- and Post-Enactment Periods*

Outcome Measures	Age (years)	Pre-Enactment**	Post-Enactment†	Contrast Ratio (Post/Pre) With 95% CI
Abortion Rate††	15–17	19.012	13.635	0.717 (0.692, 0.743)
	18–19	38.181	34.638	0.907 (0.883, 0.932)
	20–44	13.280	13.931	1.049 (1.034, 1.064)
Birth Rate††	15–17	17.663	15.510	0.878 (0.848, 0.909)
	18–19	57.338	50.213	0.876 (0.857, 0.895)
	20–44	77.982	76.191	0.977 (0.971, 0.983)
Abortions/Births	15–17	1.076	0.879	0.817 (0.777, 0.859)
	18–19	0.666	0.690	1.036 (1.000, 1.074)
	20–44	0.170	0.183	1.074 (1.057, 1.091)
Early Abortion Rate ††	15–17	15.343	10.507	0.685 (0.658, 0.713)
	18–19	32.413	28.749	0.887 (0.861, 0.914)
	20–44	12.032	12.554	1.043 (1.027, 1.059)
Late Abortion Rate††	15–17	3.653	3.114	0.852 (0.788, 0.921)
	18–19	5.750	5.867	1.020 (0.952, 1.093)
	20–44	1.247	1.375	1.103 (1.052, 1.157)
Late/Early Abortions	15–17	0.238	0.296	1.245 (1.140, 1.359)
	18–19	0.177	0.204	1.150 (1.067, 1.241)
	20–44	0.104	0.110	1.058 (1.006, 1.112)

*Raw data provided by the Minnesota Center for Health Statistics.
**Geometric mean, years 1978–80, Table 1.
†Geometric mean, years 1982–85, Table 1.
††Abortion, birth, early abortion and late abortion rates are expressed as the number of abortions or births per 1000 women.
NOTES: 1) Early abortions: ≤12 weeks; Late abortions: >12 weeks.
2) Pre-enactment (1978–80) to post-enactment (1982–85) means are compared (post/pre) in the form of contrast ratios. A contrast ratio of one implies no pre-enactment to post-enactment change.

TABLE 3—Age by Time Interactions*

Outcome Measures	Age Group Comparison	Post- / Pre-enactment Ratios** Younger	Post- / Pre-enactment Ratios** Older	Contrast Ratio (younger/older) with 95% CI
Abortion Rate	15–17 vs 18–19	0.717	0.907	0.791 (0.756, 0.827)
	15–17 vs 20–44	0.717	1.049	0.684 (0.658, 0.710)
	18–19 vs 20–44	0.907	1.049	0.865 (0.839, 0.892)
Birth Rate	15–17 vs 18–19	0.878	0.876	1.003 (0.962, 1.045)
	15–17 vs 20–44	0.878	0.977	0.899 (0.867, 0.931)
	18–19 vs 20–44	0.876	0.977	0.896 (0.876, 0.917)
Abortions/Births	15–17 vs 18–19	0.817	1.036	0.788 (0.741, 0.839)
	15–17 vs 20–44	0.817	1.074	0.761 (0.722, 0.802)
	18–19 vs 20–44	1.036	1.074	0.965 (0.928, 1.003)
Early Abortions	15–17 vs 18–19	0.685	0.887	0.772 (0.735, 0.812)
	15–17 vs 20–44	0.685	1.043	0.656 (0.629, 0.685)
	18–19 vs 20–44	0.887	1.043	0.850 (0.822, 0.879)
Late Abortions	15–17 vs 18–19	0.852	1.020	0.835 (0.753, 0.927)
	15–17 vs 20–44	0.852	1.103	0.772 (0.705, 0.846)
	18–19 vs 20–44	1.020	1.103	0.925 (0.850, 1.006)
Late/Early Abortions	15–17 vs 18–19	1.245	1.150	1.082 (0.963, 1.215)
	15–17 vs 20–44	1.245	1.058	1.177 (1.064, 1.302)
	18–19 vs 20–44	1.150	1.058	1.088 (0.994, 1.191)

*Raw data provided by the Minnesota Center for Health Statistics.
**Post- / pre-enactment ratios are from Table 2.
NOTES: 1) Early abortions: ≤12 weeks; Late abortions: >12 weeks.
2) Post-enactment to pre-enactment ratios (Table 2) are compared across age groups (younger/older) to examine age by time interactions. A contrast ratio of "one" implies equivalent post- / pre-enactment ratios for both age groups (no interaction).

the abrupt nature of the change in abortion rate, a phenomenon found also in Massachusetts by Cartoof and Klerman,[1] makes these rival hypotheses less tenable. In any event, the data argue against Clary's[3] concern that more minors might carry pregnancies to term as an indirect effect of the parental notification law. If such were the case, it seems unlikely that birth rates would have continued to decline in 15–17 year-olds along the linear trend line established prior to the law, or that the decline in birth rates would be nearly identical between 15–17 and 18–19 year-old women.

The pre-enactment to post-enactment increase in the proportion of late (>12 weeks) to early (≤12 weeks) abortions was greater for 15–17 than for 20–44 year-old women. At least two hypotheses may explain this finding. First, the law may have been more successful in preventing pregnancy among minors who would have had early abortions than among minors who would have had late abortions. A second possibility is that the law caused delays for a greater percentage of a declining number of minors seeking abortions. Regardless, the claim that the law caused more minors to obtain late abortions is unsubstantiated. In fact, the reverse is true. For ages 15–17 the number of late abortions per 1,000 women decreased following the enactment of the law. Therefore, an increased medical hazard due to a rising number of late abortions was not realized.

In this paper no effort has been made to confront the philosophical and legal issues surrounding parental involvement laws. Rather, the authors have pursued a limited task, that of empirical evaluation within a framework of defined outcome parameters. This study is consistent with the hypothesis that conception among minor women may be reduced immediately following enactment of parental notification legislation when migratory abortion across state lines is not a viable alternative. However, generalizations to other states must be made cautiously, as Minnesota is a unique state with a low minority population and a low pregnancy rate even before the parental notice legislation. The authors emphasize that replication in states other than Minnesota will be required to sustain the hypothesis. ☐

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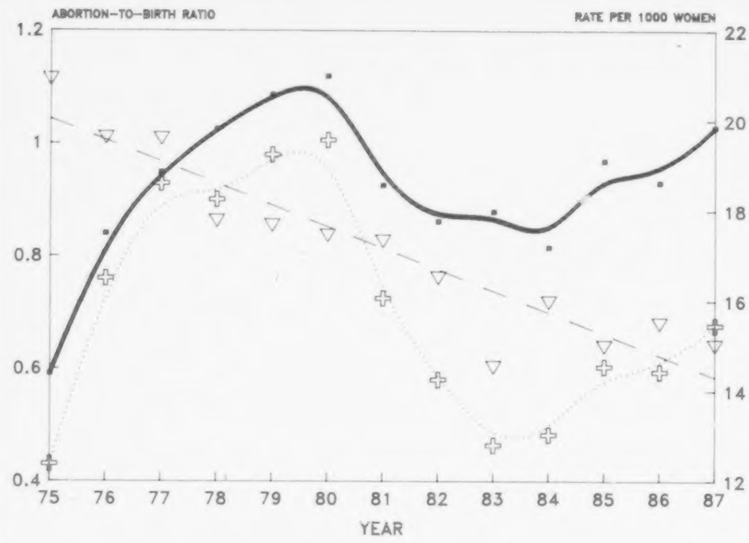

FIGURE 1—Abortion and Birth Rates per 1000 15–17 Year-Old Women and Abortion/Birth Rate Ratio, 1975–87
—Abortion/Birth Ratio
···✣··· Abortion Rate
–▽– Birth Rate

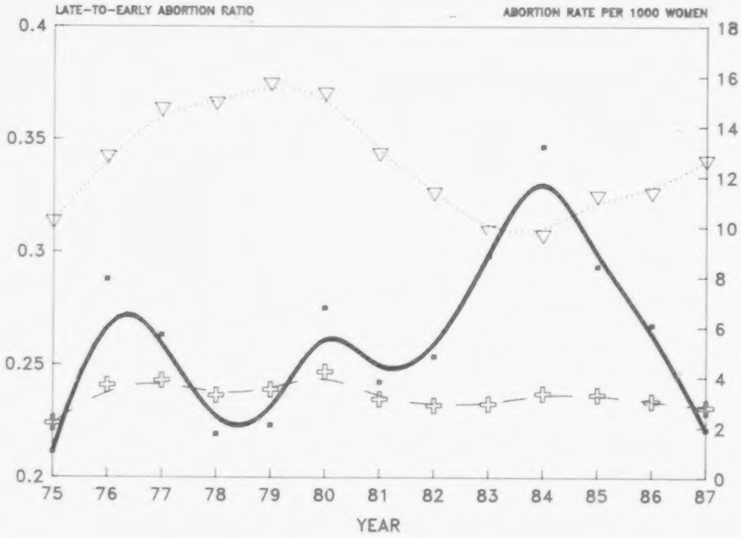

FIGURE 2—Early and Late Abortion Rates per 1000 15–17 Year-old Women and Late/Early Abortion Rate Ratio 1975–87
—Late/Early Ratio
–✣– Early Abortion Rate
···▽··· Late Abortion Rate

erable work in providing these data in a form suitable for the current analysis. The authors also thank Americans United for Life for purchasing the data from the Minnesota Center for Health Statistics and providing it to the authors. Preparation of this study was supported in part by an Aldeen Grant from Wheaton College.

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Psychosocial Factors in Maternal Phenylketonuria: Prevention of Unplanned Pregnancies

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ABSTRACT

Background. Women with phenylketonuria (PKU) not treated prior to conception can have a pregnancy that results in serious fetal damage. In this report, factors associated with preventing unplanned (and hence late treated) pregnancies are described.

Methods. Subjects included 60 phenylketonuric women and two comparison groups composed of female acquaintances and diabetic women. All were interviewed and administered tests of intelligence, general well-being, knowledge, and personality.

Results. Thirty-five percent of the sexually active women with PKU used contraception only sporadically. The variables that best predicted reported frequency of birth control use were the extent to which women felt social support to use contraception ($r = .64$) along with positive attitudes about birth control ($r = .66$) and knowledge of family planning ($r = .43$). For the comparison groups, a different pattern of variables predicted contraceptive use, with locus of control figuring most prominently for the diabetics ($r = .39$) and social support for birth control being most important for the acquaintances ($r = .46$).

Conclusions. As more girls with PKU enter childbearing ages, there will be an increased need for specific programs that address psychosocial factors in maternal PKU. (*Am J Public Health* 1991;81:299–304)

Introduction

Maternal phenylketonuria (PKU) as a cause of mental retardation and birth defects is a new phenomenon. In the past, most young women with PKU (an inborn error of phenylalanine metabolism) were mentally retarded and few bore children. Now, most such women are mentally normal, having been born since newborn screening was initiated in the 1960s and treated from early infancy with a phenylalanine-restricted diet.[1] In the United States there may be as many as 4,000 women of childbearing age with PKU,[2] the majority of whom are at risk for pregnancies that can result in abnormal children. For those with the most severe and most common form of PKU, the frequencies of complications in offspring from untreated pregnancies are 92 percent for mental retardation, 73 percent for microcephaly, 12 percent for congenital heart disease, and 40 percent for low birth weight.[3] In fact, it is feared that in the next generation, the consequences of maternal PKU could replace the number of individuals with PKU in whom mental retardation has been prevented by newborn screening.[4, 5]

Dietary treatment will protect the fetus but only under the proper circumstances. Treatment begun prior to conception and continuing throughout pregnancy appears to offer maximum protection, whereas treatment even in the first trimester may not prevent some of the adverse effects of maternal PKU.[6,7] Since many young women with PKU discontinued the special diet during childhood,[8] the strategy for preventing birth defects from maternal PKU must include careful family planning so that diet can be initiated before conception.

Tracking adolescents and young adult women with PKU so that they can be advised of the high risk to their pregnancies and the possibilities of treatment is difficult, but with much effort can be done.[2] In Quebec, there is a registry that tracks individuals with PKU through adulthood.[9] The results of other tracking efforts, however, indicate that women with PKU usually seek treatment after they are pregnant rather than before.[7,10,11] The reasons for this are unknown.

The overall purpose of our study is to identify these reasons. We will describe how women with PKU face questions of sexuality and childbearing in order to determine the factors related to preventing unplanned pregnancies in maternal PKU.

We describe here the findings from the initial interviews of all subjects who were not planning a pregnancy and were not pregnant when the study began in 1985.

Methods

Subjects

Young women in New England known to have hyperphenylalaninemia, ages 16 to 35 years, were invited to participate in a five-year longitudinal study.

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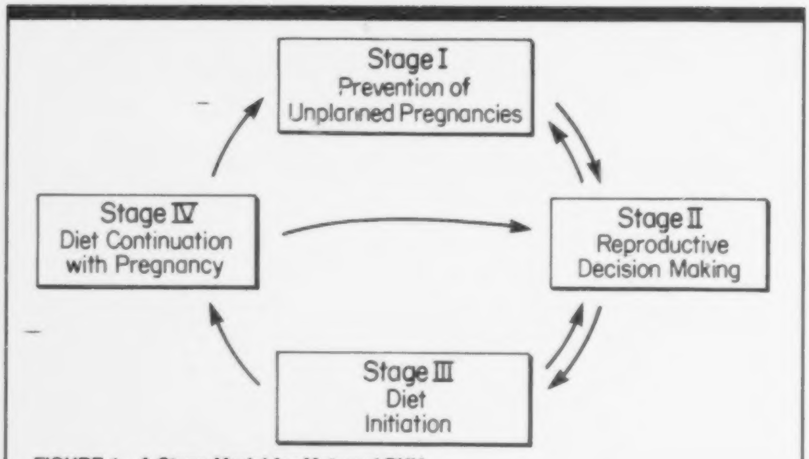

FIGURE 1—A Stage Model for Maternal PKU

Women with moderate or severe mental retardation were excluded from the sample. Recruiting from clinic lists, newborn screening records, and public health registries, we contacted all women with PKU who met the inclusion criteria regarding age and intellectual functioning. We developed two comparison groups—one consisting of age-matched female acquaintances recruited among those whose names were supplied by the subjects and the other consisting of young women with diabetes, who share childbearing risks and the need for medical intervention prior to and during pregnancy with PKU women.[12,13] Each diabetic woman, who had been diagnosed for at least one year and had no major medical complications, was individually matched to a PKU subject for age, and whenever possible, for level of education and marital status.

Two hundred and sixty-two women satisfied the criteria for inclusion in the longitudinal study, and 205 agreed to participate. These included 94 percent of the eligible women with PKU, 74 percent of the acquaintances, and 62 percent of eligible diabetics. Among the 205 who participated, 186 were sexually inactive or sexually active but not desiring pregnancy and were enrolled in the phase of the study concerned with preventing pregnancy. These 186 consisted of 60 with PKU, 65 acquaintances, and 61 with diabetes.

Among the 60 subjects with PKU, 53 have the more severe biochemical defects (classic or atypical PKU) that will require resumption of treatment prior to pregnancy.[3] Seven of the subjects have mild hyperphenylalaninemia, a less severe biochemical defect often left untreated during childhood. Because it is unclear whether mild hyperphenylalaninemia requires dietary treatment during pregnancy,[14,15] these women were included in the PKU group.

Most subjects with PKU had received a written brochure about maternal PKU and had been invited to maternal PKU education groups. Thirty-eight women had attended at least one group. However, the majority had not attended a PKU clinic within the year prior to the study. As a rule, the women had been advised to plan their pregnancies, begin diet, and reduce blood phenylalanine levels before discontinuing contraception. A few had been advised not to have children and to plan on adoption or to wait until more was known about maternal PKU.

Fifty-eight of the 61 women with diabetes (95 percent) are insulin dependent (Type I), while the other three have been treated only with diet (Type II).

Variables and Procedures

Variables for this study were derived from a psychosocial model we developed to describe the challenges faced by women with PKU during various stages in the maternal PKU life-cycle[16] (see figure 1). These variables were selected from a variety of theoretical approaches and covered background issues, personality, knowledge, attitudes and beliefs, and social support. We chose our initial battery after first developing a list of hypotheses regarding prevention of unplanned pregnancy in maternal PKU. This initial battery was piloted extensively among teenagers and women with no known medical conditions, women with diabetes, and older women with PKU.

The dependent (outcome) variables for those women who reported having had sexual intercourse (the sexually active group) were frequency of birth-control use, extent of social activities, and a general quality-of-life score. Frequency of birth-control use refers to the regularity with which a woman reported using any contraceptive method. She indicated this by selecting the frequency of use, on a one to seven scale, ranging from "never" to "all the time." The type of birth control method was related to frequency, with oral contraceptives generally being used "all the time" and all other methods being used less often. Hence, for data analysis purposes, the "frequency" rather than "type" of birth control was selected.

The second outcome variable, extent of social activities, measures the types of activities the woman listed that involve social interactions, such as membership in clubs, participation in religious groups, sports, dating, and parties. This variable was selected to determine if women with PKU avoided certain social situations, perhaps due to anxiety about maternal PKU.

The third outcome variable, the General Health Rating Index (GHRI),[17] measures the degree to which people worry about their health, experience pain, or alter their life-style for health reasons. These topics were also explored in open-ended questions. The responses to the open-ended questions were categorized according to whether the answer was neutral, positive, negative, or a combination of these. All ratings were double-scored, and reliability was greater than 95 percent.

For women who reported never having had sexual intercourse (the sexually inactive group), the social activities scores and the GHRI were the outcome measures.

The independent variables included demographic factors, level of intelligence, knowledge about family planning, knowledge about maternal PKU, personality characteristics, social support for family planning, and attitudes and beliefs about contraception, sex, and childbearing.

The interview consisted of introductory questions that provided demographic information. Socioeconomic status was determined using the Hollingshead-Redlich Two Factor Index of Social Position, based on education and job title.[18] Intelligence was measured by the Wechsler Adult Intelligence Scale-Revised (WAIS-R)[19] or the four-subtest short form of the WAIS-R,[20] when a full-scale score was not available from clinic records.

A test of fertility and contraception knowledge, adapted from Kempton and Forman[21] and a test of knowledge about

TABLE 1—Characteristics of the Subjects

	Study Group	Comparison Groups	
	PKU	Diabetes	Acquaintances
Number	60	61	65
Age (mean ± SD)	20.8 ± 3.6	21.2 ± 3.6	20.8 ± 3.9
Married	7% (4)	12% (7)	11% (7)
Experienced pregnancy	8% (5)	33% (20)	25% (16)
Have child/children	3% (2)	13% (8)	15% (10)
Live with parents	83% (50)	64% (39)	59% (38)
Have driver's license	58% (35)	84% (51)	74% (48)
Education (mean ± SD)	11.9 ± 1.7	13.2 ± 2.1	12.8 ± 1.8
IQ (mean ± SD)	86 ± 14	96 ± 11	96 ± 14

TABLE 2—Sexual Activity and Type and Frequency of Birth Control Use among Women with PKU and Comparison Populations

	Study Group		Comparison Groups			
	PKU		Diabetes		Acquaintances	
	%	(n)	%	(n)	%	(n)
Not Sexually Active	57	(34)	29	(18)	34	(22)
Sexually Active	43	(26)	71	(43)	66	(43)
Method of Birth Control						
Oral Contraceptives	46	(12)	32	(14)	51	(22)
Condom	19	(5)	14	(6)	14	(6)
Diaphragm	5	(1)	9	(4)	5	(2)
Sponge	4	(1)	7	(3)	7	(3)
Tubal Ligation	4	(1)	7	(3)	2	(1)
Rhythm	4	(1)	5	(2)	2	(1)
Intrauterine Device	0		0		0	
No method	19	(5)	26	(11)	19	(8)

maternal PKU[22] (and a comparable test for women with diabetes) were devised for this study. These tests gave one point for a correct response, with 13 possible points for the contraception knowledge test and ten points for the knowledge of maternal PKU and diabetes tests.

Personality was measured by the Adult Nowicki-Strickland Internal-External Locus of Control Scale[23] and the Rosenberg Self-Esteem Scale.[24]

Social support for birth control was determined, as suggested by Fishbein[25] and Vinokur-Kaplan,[26] by asking subjects to name the three people to whom they felt closest and then to rate on a seven-point scale the degree to which each of these people would support their using birth control. The mean ratings constituted the score for social support for birth control.

Attitudes and beliefs were defined by a series of statements to which subjects indicated the extent of their agreement on seven-point scales. These statements, adapted from published studies, were about sexual activity, use of birth control, attitudes regarding contraception, and past pregnancies.[27,28] A composite "attitude towards birth control" score was developed from responses to three questions regarding the benefits, advisability, and comfort in using and procuring contraception.

Each woman in the study was interviewed either in her home or at the hospital. All written questionnaires required no more than a sixth-grade reading level. To increase the comfort of the subjects (and to ensure confidentiality), response cards for personal questions concerning sexual activity, birth control, and pregnancy were provided. Each session lasted about two hours.

Data collection also included review of medical records for information on diagnosis and treatment of PKU or diabetes.

Data were analyzed utilizing the Statistical Package for the Social Sciences (SPSS).[29] To determine differences between the study groups, chi-square or one-way analyses of variance (with Scheffé tests for pairwise comparisons) were used. Pearson correlations were used to identify variables related to successful achievement of outcome goals.

Consent procedures standardized by the Children's Hospital (Boston) Committee on Clinical Investigations were followed.

Results

Characteristics of the Sample

Demographic and other background characteristics of the three groups are listed in Table 1. The groups are similar in age, with a mean of approximately 21 years at the time of the study. The frequencies of those who had been pregnant or had a child were less among the women with PKU. Women with PKU were more likely to live with their parents, were less likely to have a driver's license, had fewer years of education, and had a lower mean IQ. Six women with PKU and one acquaintance (but none with diabetes) performed in the range of mild mental retardation, with scores between 60 and 67.

Prevention of Unplanned Pregnancies

As noted in Table 2, 43 percent of the women in the PKU group reported that they were currently or had been sexually active, a smaller proportion than those in the other groups. Among PKU women who had had sexual relations, 19 percent never used birth control, and 65 percent reported always using birth control when they had sexual relations. These findings, along with the type of contraception selected, were similar to those of the comparison groups. As noted in Table 3, married women with PKU were more likely to always use birth control, while unmarried women were less consistent in this respect.

Women with PKU who reported never having had sexual intercourse and those who were sexually active were similar in age, with mean ages of 20.6 and 20.9 years respectively. Less than 13 percent of both groups indicated disapproval of premarital sex and birth control.

The seven women with mild hyperphenylalaninemia did not differ from other women with PKU in terms of the demographic or psychological variables studied, except that they had a more internal locus of control (F = 9.3, SE = .39). All but two lived with their parents. Their ages ranged from 16 to 22, and their IQ ranged from 78 to 117. Five had had sexual intercourse, among whom two relied on

TABLE 3—Frequency of Birth Control Use among Sexually Active Women according to Marital Status

	Study Group	Comparison Groups	
Use of Birth Control	PKU	Diabetes	Acquaintances
Unmarried Women	22	36	36
Never Uses	5	9	6
Always Uses	13	25	27
Married Women	4	7	7
Never Uses	0	2	2
Always Uses	4	3	5

TABLE 4—Pearson Correlations between Independent Variables and Reported Frequency of Contraceptive Use among Sexually Active Women

	Study Group	Comparison Groups	
Independent Variable	PKU	Diabetes	Acquaintances
Social Support for Birth Control	.64***	.25	.46**
Attitudes about Birth Control	.66***	.22	.16
Knowledge of Family Planning	.43*	.16	.15
Knowledge of Maternal PKU/Diabetes	.03	.17	—
Personality: Locus of Control	−.14	−.39**	.07
Personality: Self-Esteem	−.08	−.17	.08
IQ	.16	.01	.03
Social Class	0	−.12	−.13

NOTE: Results were similar when analyses were redone controlling for age.
*p < .05
**p < .01
***p < .001

TABLE 5—Quality of Life among Sexually Active vs. Inactive Women with PKU

	Sexually Active	Sexually Inactive
General Health Ratings Index (mean ± SD)	82.4 ± 16.5	82.6 ± 15.2
Percent women engaged in spare-time activities		
athletics	34.6	38.2
social activities	57.7	82.4
intellectual pursuits	19.2	23.5
solitary	84.6	79.4
Percent reporting alterations in social life due to PKU	19.2	8.8
Percent reporting alterations in plans for future due to PKU	57.7	58.8
Percent reporting alterations in plans to have children	42.3	55.9

the use of condoms intermittently and three used oral contraception.

Factors Associated with Prevention of Unplanned Pregnancy

As noted in Table 4, the degree of social support for birth control that PKU women received from individuals in their social network and their own attitudes about birth control, including comfort in discussing birth control with a health care provider, were critical factors for contraceptive behavior, correlating .64 and .66 respectively with frequency of contraceptive use. In addition, knowledge of family planning, but not knowledge of maternal PKU, correlated with frequency of contraceptive use. Among women with PKU, personality variables, age, marital status, living situation, IQ, and social class were unrelated to contraceptive use. Multiple regression analyses indicated that when the variable for either social support for birth control or the attitudes about birth control was entered first in the equation, no other variables were significant.

A different pattern of variables predicted contraceptive use for the comparison groups, with only locus of control figuring prominently for the diabetics and only social support for birth control being important for the acquaintances.

Compared with their acquaintances and women with diabetes, women with PKU attained lower scores on the Knowledge of Family Planning Test (F = 7.8 SE = .14) and had a more external locus of control (F = 9.3 SE = .4).

Quality of Life

As noted in Table 5, for women with PKU, the scores on the GHRI were comparable for those who were sexually active and those who were not. In general, they were involved in similar types of spare-time pursuits, although the women who reported never having had sexual relations were somewhat more likely to engage in social activities. Few of the sexually active or sexually inactive women reported alterations in their social lives because of PKU. Women with PKU who identified negative effects from their disease reported having fewer friends, fewer activities, difficulties explaining their disease to boyfriends, and concerns about becoming sexually involved. More than half in each group reported alterations in their plans for the future due to PKU. Somewhat more of the sexually inactive women mentioned concerns about maternal PKU, and equal numbers mentioned reduced career opportunities as a consequence of PKU-related learning disabilities. Nonetheless, compared with women with diabetes, women with PKU attained significantly higher scores on the GHRI (F = 16.5 SE = 1.5), indicating less worry, less pain, and less of a negative impact from their disease. Fifty percent of women with PKU, compared with 85 percent of women with diabetes, reported undesirable alterations in their social activities and plans for the future as a consequence of their disease.

Discussion

Until now studies of individuals with PKU have focused on intellectual and academic development. However, the necessity for treatment prior to pregnancy in maternal PKU stimulated us to investigate other aspects of development. In this study, we concentrated on those psychosocial factors in young women with PKU that we believe will be important in their meeting the challenges of family planning in maternal PKU.

We found that many young women with PKU tend to live with their parents and to be without a driver's license. Nonetheless, they are engaged in social activities and competitive employment. They plan to marry and bear children. It is unclear why fewer women with PKU reported having had sexual intercourse compared with their acquaintances and the diabetic women, who were similar in age and marital status. We believe, however, that over the next few years, more will become sexually active. Unfortunately, those who are sexually active seem to be at high risk for unplanned pregnancies, since 35 percent of them report only intermittent use of birth control.

It appears that social support for birth control and positive attitudes about contraception each have a very significant influence on the reported contraceptive behavior of young women with PKU. These findings are consistent with Fishbein's theory of reasoned action, which states that attitudes, social norms, and the willingness to comply with these norms are predictors of behavior.[30-32]

With the exception of social support, those factors that correlate with birth control use in women with PKU are specific to them and unlike correlating factors in the two comparison groups studied. For instance, their external locus of control does not predict contraceptive frequency; yet in the diabetic subjects and in published studies, an external locus of control is associated with infrequent contraceptive use.[33-34] On the other hand, knowledge of family planning is significantly correlated with reported frequency of birth control use only in the PKU women. Their knowledge of family planning, in general, is lower than that of the other subjects studied and, in many instances, may be sufficiently low to impair their ability to choose and use contraceptive measures. Education programs such as those described by Cohen and his colleagues in Israel[35] may be beneficial to these women. In developing our test of knowledge of maternal PKU, we found that knowledge scores were higher among the 38 women who had attended a PKU education group than among the 22 who had not done so.[22] Finally, although the women with PKU have attitudes about birth control that are comparable to those of their acquaintances and the diabetic women, their contraceptive behavior appears to be more highly influenced by their attitudes. Further analyses show that although IQ is significantly related to knowledge of family planning and knowledge of maternal PKU, it is not significantly related to the frequency of contraceptive use.

In addition to these findings, we gained a keener sense of how women with PKU approach the question of childbearing. The vast majority consider having children a natural sequel to finding a husband, and few acknowledge that an unplanned pregnancy might occur. In these attitudes, they are similar to adolescents confronting a variety of medical and health issues.[36]

We also learned more about the ways in which women with PKU related to health care providers. As a group, they were extraordinarily cooperative, perhaps reflecting a sense of trust developed over years of association with the PKU programs. Ninety-four percent of those contacted participated in the study. Despite this cooperation, only a few of the women made follow-up clinic appointments. This may be due to apprehension about the blood test and physical examination, to a belief that they already know enough about maternal PKU, or to a presumption that an unplanned pregnancy was not likely to occur.

Women with PKU were self-accepting, as indicated by their responses to the self-esteem questionnaire. Many expressed the thought that they "used to have" PKU when they were children on the special diet. For them, prevention of unplanned pregnancies may have been no different than it was for other teenagers and young adults striving for a sense of identity and independence. The risks to the fetus could easily be forgotten or ignored during this time of self-exploration. This may explain why birth control practices among those with PKU were no better than those of the acquaintances who did not face known childbearing risks. On the other hand, fewer women with PKU were sexually active, perhaps due to fears of unplanned pregnancies, to concerns regarding risks to the fetus, or to limited social opportunities. These speculations regarding the psychological impact of PKU will be explored further as the study continues. Social support will also receive more intensive examination in the continuing study. We plan to define social support more precisely in terms of the nature of support networks, the importance of peers versus family, the role of perceived as opposed to actual support provided, and the extent to which the concept reflects general support as compared with specific encouragement for birth control use.

As in any study dependent on self-report, the reliability and validity of the subjects' responses should be checked. We asked several duplicate questions, worded slightly differently, so that inconsistent answers about sexual activity and birth control use could be verified. Our sense was that the women were generally honest. Since this is a longitudinal study, each subject will be interviewed at least five times, and further checks can be made on the consistency and reliability of the results.

In the near future as more girls with PKU enter childbearing ages, the need for specific programs for maternal PKU, already serious, will dramatically increase. A critical first step is to develop a registry in the United States similar to that in Canada to track women with PKU so that information and services can be provided. Our society and its health care system must confront the issue of maternal PKU. To ignore the issue is to punish those who because of their inherited condition are at risk for bearing defective children. ☐

Acknowledgments

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Conference of Public Health Laboratorians 1991 Kimble Methodology Award

The Kimble Methodology Award, sponsored by the Conference of Public Health Laboratorians and supported by Kimble Glass, Inc., Vineland, New Jersey is intended to recognize significant contributions to the development of diagnostic methodology for use in the public health or diagnostic laboratory. The 1990 Award winners were Dr. Robert E. Weaver and Ms. Dannie G. Hollis, Special Bacteriology Laboratory, Centers for Disease Control, Atlanta, Georgia, for their work on the characterization and identification of numerous genera and species of medically important bacteria.

Nominations are being sought for the 1991 Kimble Methodology Award, (the 40th annual award) to be presented at the annual meeting of the Conference of Public Health Laboratorians scheduled for November 10, 1991 in Atlanta, Georgia. The award consists of a $1,000 check and a plaque presented by Kimble Glass. In addition, travel and subsistence will be paid for the recipient to attend the 1991 Conference meeting.

The deadline for submission of nominations for the 1991 award is June 17, 1991. All nominations should be entered according to the following rules:

•Nominee's work should be a fundamental contribution, or an adaptation of such, to diagnostic methodology for use in the public health or diagnostic laboratory. Degree of acceptance and use of the methodology will be considered.

•Nominee(s), either an individual or two or more working together, must live and work on the North American continent.

•The nomination (10 copies) shall consist of a letter describing the reason for nomination; the recognition accorded the nominee for the work and the degree of acceptance by and/or its importance to the work of public health or diagnostic laboratories; the curriculum vitae of the nominee; the nominee's current place of employment; a list of the nominee's publications along with reprints of representative recent publications; and, optionally, letters of support for the nomination.

Send nominations to: Hilton T. Goulson, PhD, Kimble Award Chairperson, Department of Parasitology and Laboratory Practice, UNC School of Public Health, CB #7400, Chapel Hill, NC 27599-7400. Tel: (919) 966-3892.

Predicting Onset and Chronicity of Women's Problem Drinking: A Five-Year Longitudinal Analysis

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ABSTRACT

Background. Longitudinal studies of adult drinking have typically excluded or sampled only small numbers of problem drinking women, and have measured a limited range of influences on women's drinking behavior.

Method. To study the development of women's problem drinking over time, five-year follow-up interviews were conducted with two groups of respondents from a 1981 national survey of women's drinking: 143 problem drinkers and 157 nonproblem drinkers. Regression analyses examined effects of 1981 predictors on six measures of 1986 problem drinking, for problem drinkers and nonproblem drinkers separately.

Results. Among 1981 nonproblem drinkers, predictors of onset of problem drinking indicators by 1986 included younger age, cohabiting, and lifetime use of drugs other than alcohol. The most consistent predictor of persistent (chronic) problem drinking was sexual dysfunction; other predictors included being employed part-time or never married, and experiencing recent depression. Divorce or separation predicted *lower* levels of subsequent alcohol dependence among problem drinkers.

Conclusions. Findings suggest that different personal and social factors predict the onset of problem drinking as compared with its continuation, and point to nontraditional life-style, sexual dysfunction, and role deprivation as potentially important variables. (*Am J Public Health* 1991;81:305–318)

Introduction

Longitudinal research on general population samples is essential for predicting the onset and chronicity of problem drinking, but has not been adequately applied to the study of women drinkers. A majority of the longitudinal studies in a recent comprehensive review[1] totally excluded female respondents. Of 12 longitudinal studies of adult drinking included in an international collaborative effort,* four have exclusively male samples, while only one focuses primarily on females.

Those longitudinal studies that do sample women frequently have insufficient numbers of heavy drinking and problem drinking women for multivariate analysis, due to the lower rates of heavy drinking and drinking-related problems among women than among men. Even a relatively large national probability sample of 2,000 respondents (half female) yields only 30 to 60 women who drink as heavily as 14 drinks per week.[2] One frequently cited longitudinal study[3] had only three women in its problem drinker sample. In addition, most longitudinal studies that include women have focused on immediate contexts and correlates of drinking behavior, with relatively little attention to other or longer term influences on women's drinking.

The five-year longitudinal study reported here gathered information about diverse antecedents and consequences of drinking and drinking problems in women. This paper addresses two major questions: 1) What factors predict the incidence (onset) of problem drinking among women over a five-year period? 2) What factors predict the chronicity—continuation or worsening—of women's problem drinking over five years? Because drinking may be reciprocally related to a number of personal and social-environmental conditions, we analyze drinking as both a predictor and an outcome of these conditions.

Methods

Sampling

The data are from a national survey of women's drinking conducted in the fall and winter of 1981 and from a follow-up survey in the fall and winter of 1986. Sampling and fieldwork for both surveys were conducted by the National Opinion Research Center (NORC).

The 1981 survey interviewed a stratified probability sample of the noninstitutionalized US population age 21 and over, obtained from initial screening of 4,032 households. After 10-minute screening interviews to determine women's drinking levels, NORC interviewers requested interviews from every moderate-to-heavy drinking woman (four or more drinks per

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*Fillmore KM, Hartka E, Johnstone BM, Leino V, Motoyoshi M, Temple MT: Life course variations in drinking: Preliminary results from the Collaborative Alcohol-Related Longitudinal Project. Paper presented at the 15th Annual Alcohol Epidemiology Symposium, Kettil Bruun Society for Social and Epidemiological Research on Alcohol, Maastricht, The Netherlands, June 11–16, 1989.

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week), from every woman reporting a history of drinking-related problems, and from one of every four lighter drinking or abstaining women. Interviews were completed with 500 moderate-to-heavy drinking women and 39 women who were self-reported former problem drinkers (89 percent completion rate), and with 378 lighter drinking and abstaining women (83 percent completion rate). A probability sample of 396 men (66 percent completion rate) was also interviewed as a comparison group. Detailed information about sample design, statistical weighting, and comparisons with other national data are provided elsewhere.[2,4]

The 1986 follow-up survey compared two subsamples of female respondents. Problem Drinkers (PDs) were women who in 1981 had reported at least two of the following: 1) average consumption of one or more ounces of ethanol per day; 2) one or more drinking-related problems in the past 12 months; and 3) one or more alcohol dependence symptoms in the past 12 months. These problem drinking criteria are similar to those used in other studies,[5–7] and the proportion of women thus identified—10.1 percent of the total weighted female sample—falls in the middle of the range of estimates of problem drinking rates among women in US surveys during the 1960s and 1970s (1 percent to 21 percent).[6] Nonproblem Drinkers (NPDs) were women who in 1981 drank more than one drink per month but reported none of the three problem drinking indicators.

Application of these criteria produced samples of 178 PDs and 199 NPDs. Of these, 157 PDs (88.2 percent) and 185 NPDs (93.0 percent) were successfully located by NORC staff. Six percent of the total follow-up sample (five PDs and 16 NPDs) were deceased, too ill or senile to be interviewed, or out of the country. Of the remaining respondents potentially available for interviews, interviews were completed with 143 PDs (94.1 percent) and 157 NPDs (92.9 percent). The final sample thus represents 80.3 percent (143 of 178) of all PD cases in the 1981 sample and 78.9 percent (157 of 199) of all 1981 NPDs. (Not included in the follow-up sample were 290 women who abstained at least 30 days before the 1981 survey, 110 infrequent drinkers who drank one drink per month or less in the 12 months preceding the survey, and 140 women who drank more than one drink per month and who reported only one of the three problem drinking indicators.)

In order to assess possible selection bias due to attrition, nonresponse rates (combining refusals and locating failures) were examined for respondent categories based on all major drinking variables, seven major demographic variables, and two sexuality variables (nontraditional sexual behavior and sexual dysfunction), within PD and NPD subsamples separately. Nonresponse rates for the following categories exceeded the overall subsample nonresponse rates by 15 percent or more: Black PDs; NPDs age 71 and older; PDs separated from their husbands; PDs with household income under $8,000; NPDs with household income $8,000–$15,000; NPDs completing college but not graduate school; NPDs who were retired or disabled; and NPDs reporting both masturbation and premarital sexual experience. None of the drinking variables had categories with excessive nonresponse rates. Based on their known or expected relationships to other variables, income and race seemed to be the two most important variables for weighting adjustments. Accordingly, nonresponse weighting adjustments were applied to the 1986 sample based on division of the PD and NPD subsamples into three categories: Blacks; race Other/income under $15,000; race Other/income $15,000 and above.

Data Collection

The 1981 survey questionnaire was administered face-to-face by female NORC interviewers. It included questions (described below) about drinking behavior, drinking-related problems, alcohol dependence symptoms, and lifetime drinking history. Other questions dealt with demographic characteristics, family history and socialization, personality traits and values, social roles, characteristics of the respondent's primary interpersonal relationship, stressful life events, depression, sexual experience, reproductive dysfunction, use of drugs other than alcohol, and antisocial behavior.

The follow-up survey, again administered by female NORC interviewers, used measures of drinking behavior and drinking consequences identical to those used in 1981. Other questions asked about changes in demographic characteristics such as marital and employment status since 1981, and about other major life events such as births, deaths, physical illness, depression, and sexual and reproductive dysfunction. New questions addressed employment experiences, feelings of role overload and role deprivation, sexual experience and sexual abuse, and relationship conflict/violence.

Measures

Predictor Variables: The 1981 survey was designed to assess the individual and combined effects of a large number of variables that had been associated with women's drinking in previous theory and research, as well as additional variables not addressed in earlier work. The conceptual model guiding the study assumed that a woman's demographic and family background (including such variables as age, education, religious orientation, and recalled parental behavior including drinking) affects three major sets of influences on drinking behavior: 1) personality characteristics (including personal motives and values, drinking-related beliefs and attitudes, and gender-role attributes); 2) perceived social environment (including social norms and interactions with significant others); and 3) life experiences (including stressful life events, sexual and reproductive experience, affective disorder, other drug use, and antisocial behavior). Background, personality, social environment, and life experiences all influence contexts of drinking behavior, levels of alcohol consumption, and drinking consequences.[8] From the large set of variables initially included in the 1981 survey, variables were selected for the present longitudinal analyses if they had shown a significant positive relationship to heavier drinking and/or to adverse consequences of drinking in earlier cross-sectional analyses of 1981 data.[2,4,8–13]

Time 1 predictors were demographic characteristics, personality attributes, social-environmental conditions, and life-history events as measured in the 1981 survey. For some variables, additional interim predictors consisted of specific changes in demographic status (e.g., becoming divorced or unemployed) or major life experiences (e.g., miscarriage/stillbirth, depressive episode) during the 1981–86 follow-up interval. We also measured the Time 2 (1986) values of Time 1 predictors in order to analyze possible Time 2 consequences of Time 1 drinking. Brief descriptions of personality variables, sexuality-related variables, and drinking variables are provided in the Appendix; descriptions of all other variables can be obtained by writing the authors.

Drinking Variables: Questions about the frequency and quantity of consumption of wine, beer, and liquor were used to estimate respondents' average daily intake in ounces of ethanol per day for the 30 days preceding the survey.[5,14] Minor refinements in the 1986 survey adjusted for

TABLE 1—Changes in Problem Drinking Indicators, 1981–86, among 1981 Nonproblem Drinkers (NPDs) and Problem Drinkers (PDs), by Age (%)

1986 Problem Drinking Indicators	Age 21–34		Age 35–49		Age 50+		Total	
	NPDs	PDs	NPDs	PDs	NPDs	PDs	NPDs	PDs
None	73.0	37.8	95.6	25.8	95.4	26.1	88.8	32.7
One	13.8	34.8	4.4	17.1	3.4	38.3	6.9	30.7
Two or Three	13.3	27.4	0	57.2	1.2	35.6	4.3	36.5
Weighted N	(46)	(80)	(58)	(37)	(49)	(23)	(153)	(140)

the new popularity of wine coolers and low-alcohol beer, the use of malt liquor, and slight declines in the ethanol content of wine and liquor. Estimating procedures are summarized in the Appendix. Other drinking measures included the frequency of heavy episodic drinking (six or more drinks per day) and the frequency of intoxication ("feeling drunk") in the 12 months preceding the survey.

An index of nine kinds of problem consequences of drinking included driving while feeling intoxicated, starting fights (with family members or others), damage to job performance, interference with housework or chores, drinking-related home accidents and problems with children, and spouse's or partner's complaints about the respondent's drinking and threats to leave the drinker. An index of five alcohol dependence symptoms consisted of memory lapses while drinking (blackouts), rapid drinking, morning drinking, inability to stop drinking before becoming intoxicated, and inability to stop or reduce alcohol consumption over time. These indexes summed the number of different consequences and symptoms reported for the 12 months preceding the survey. A composite Problem Drinking Index (PDI) summed the occurrence in the past 12 months of 1) any episode of intoxication, 2) any problem consequence, and 3) any alcohol dependence symptom (scores ranged from zero to three).

Data Analysis

Data analysis involved weighting cases to take into account unequal probabilities of inclusion at several levels of selection, including 1981 stratification by drinking level, 1986 selection of PD and NPD samples, and response rate variations in both surveys.[4] For significance tests we adjusted weights by constant ratios to produce weighted Ns equal to the actual numbers of respondents in the PD and NPD samples.

This paper reports results of three analyses. First, cross-tabulations describe patterns of change in problem drinking indicators between the 1981 and 1986 surveys. Second, regression analyses examine the effects of individual Time 1 and interim predictors on six Time 2 drinking variables, and the effects of six Time 1 drinking variables on Time 2 values of Time 1 predictors. Dependent variables in the regression analyses were standardized residuals. Each Time 2 drinking variable was regressed on its Time 1 equivalent plus measures of 1981 consumption (average consumption and heavy episodic drinking) to produce standardized residuals as measures of Time 2 drinking patterns not predicted by Time 1 drinking patterns. Similarly, each Time 2 condition (e.g., sexual dysfunction in 1986) was regressed on its Time 1 equivalent, producing standardized residuals as measures of Time 2 conditions not accounted for by Time 1 conditions.

The third analysis uses results of the second analysis as a winnowing procedure to develop 12 unique multiple regression equations showing the combined effects of Time 1 and interim predictors on the same standardized residuals of each of six measures of Time 2 drinking, for the NPD and PD samples separately. Predictors were included in these equations 1) if they predicted ($p < .10$) the Time 2 drinking variable in the bivariate analyses described above, or 2) if they predicted ($p < .10$) the Time 2 drinking variable in (a) equations that entered all Time 1 predictors simultaneously, or (b) equations that entered all predictors simultaneously, using interim predictors for those variables with both Time 1 and interim versions. Every equation included age as a control variable. In the 12 final equations, predictors were entered hierarchically in two steps: Time 1 predictors (those that occurred before 1981 or that constituted the respondent's status in 1981), followed by interim predictors (occurring during the follow-up interval). Based on earlier cross-sectional findings, every predictor (except age) in the second and third analyses was hypothesized to predict heavier drinking or more adverse drinking consequences. For this reason, one-tailed tests of significance were used for relationships in the predicted direction, two-tailed tests for relationships in the opposite direction.

Design effects were assessed for seven of the resulting regression equations.[15] In only two (intoxication and PDI, among PDs only) did the mean of the individual square roots of design effects slightly exceed 1.0 (1.017 and 1.101 respectively), and the overall mean for all predictors in the seven equations was less than 1.0 (0.963). This indicates that the findings reported here are not affected by weighting or cluster characteristics of the PD and NPD subsamples to an extent that would require adjustment for departures from the simple random sampling model.

Results

Changes in Problem Drinking

Table 1 shows five-year changes in the three problem drinking indicators (consumption, problems, symptoms) used to define the 1981 NPD and PD samples. A large majority of all 1981 NPDs remained free of problems five years later; 11.2 percent had developed at least one problem drinking indicator. Of the 1981 PDs (who in 1981 had reported at least two of the three indicators), approximately one-third (32.7 percent) by 1986 reported none of the three indicators and another one-third (30.7 percent) reported only one indicator.

Patterns of change were quite different for three age groups:

- Onset of problem drinking was most common among young women age 21–34; more than one-fourth (27.1 percent) of the 1981 NPDs in this age group reported at least one problem drinking indicator by 1986, compared with 4.4 percent of 1981 NPDs age 35–49 ($\chi^2 = 8.85$,

TABLE 2—1981 Sociodemographic Predictors of Five-Year Onset and Chronicity of Problem Drinking Indicators: Hierarchical Multiple Regression Coefficients with Unadjusted (Zero-Order) Weighted Means and Rates

	Time 2 (1986) Problem Drinking Indicators						
Time 1 (1981) Sociodemographic Predictors	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1⁺)	Problem Drinker Sample Criteria (%1⁺)
Younger Age							
NPD Onset							
Beta 1	−.04	+.22	+.30	+.17	+.10	+.23	*
Beta 2	−.08	+.20	+.25	+.06	+.04	+.13	
21–34 (51)	.175	35%	52%	24%	14%	54%	27%
35+ (106)	.151	10%	6%	3%	1%	7%	4%
PD Chronicity							
Beta 1	−.05	+.15	+.15	+.02	+.05	+.11	
Beta 2	−.21	+.13	+.15	+.01	+.07	+.12	
21–34 (77)	.490	57%	75%	53%	37%	78%	62%
35+ (66)	.881	59%	63%	54%	44%	76%	74%
Unemployed, 1981							
NPD Onset							
Beta 1	—	—	—	+.07	—	—	
Beta 2	—	—	—	−.01	—	—	
Yes (10)	.213	37%	28%	28%	11%	28%	28%
No (146)	.151	17%	19%	9%	5%	21%	11%
PD Chronicity							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (7)	.457	56%	73%	44%	49%	73%	62%
No (135)	.668	58%	70%	54%	39%	77%	67%
Employed Part Time, 1981							
NPD Onset							
Beta 1	—	−.16	—	—	—	—	
Beta 2	—	−.17	—	—	—	—	
Yes (31)	.216	14%	15%	8%	4%	18%	12%
No (125)	.146	18%	20%	10%	5%	22%	11%
PD Chronicity							
Beta 1	+.13	—	—	−.16	—	—	
Beta 2	+.23	—	—	−.14	—	—	
Yes (22)	.674	53%	64%	44%	33%	70%	50%
No (119)	.637	60%	73%	56%	42%	80%	70%
Nontraditional Job for Women, 1981							
NPD Onset							
Beta 1	—	+.07	+.12	—	—	—	
Beta 2	—	+.04	+.06	—	—	—	
Yes (42)	.149	24%	26%	6%	3%	27%	9%
No (107)	.165	15%	15%	8%	4%	17%	9%
PD Chronicity							
Beta 1	—	—	−.17	—	—	—	
Beta 2	—	—	−.14	—	—	—	
Yes (47)	.630	64%	64%	52%	38%	71%	72%
No (80)	.613	55%	78%	53%	42%	84%	61%
Never Married, 1981							
NPD Onset							
Beta 1	+.06	−.01	—	—	+.12	—	
Beta 2	+.08	+.04	—	—	+.12	—	
Yes (17)	.242	34%	34%	18%	21%	34%	26%
No (140)	.151	16%	18%	9%	4%	20%	10%
PD Chronicity							
Beta 1	—	+.05	+.18	+.17	—	+.18	
Beta 2	—	+.05	+.16	+.16	—	+.14	
Yes (22)	.519	74%	86%	76%	52%	92%	87%
No (121)	.686	55%	67%	49%	38%	74%	64%
Divorced/Separated, 1981							
NPD Onset							
Beta 1	—	−.14	—	—	—	—	
Beta 2	—	−.14	—	—	—	—	
Yes (18)	.135	10%	34%	9%	3%	35%	9%
No (139)	.162	19%	17%	10%	5%	19%	12%

(*continued*)

TABLE 2—Continued

Time 1 (1981) Sociodemographic Predictors	Time 2 (1986) Problem Drinking Indicators						
	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1⁺)	Problem Drinker Sample Criteria (%1⁺)
PD Chronicity							
Beta 1	—	—	−.09	—	—	−.08	
Beta 2	—	—	−.08	—	—	−.07	
Yes (29)	.473	45%	55%	48%	23%	66%	57%
No (115)	.709	61%	74%	54%	44%	80%	70%
Cohabiting, 1981							
NPD Onset							
Beta 1	—	+.18	+.08	—	—	—	
Beta 2	—	+.17	+.06	—	—	—	
Yes (5)	.070	61%	51%	13%	0%	64%	13%
No (152)	.161	16%	18%	9%	5%	20%	11%
PD Chronicity							
Beta 1	—	−.26	—	—	—	—	
Beta 2	—	−.22	—	—	—	—	
Yes (14)	.865	24%	76%	52%	30%	76%	52%
No (129)	.633	62%	69%	54%	41%	78%	69%
Recent Empty Nest, 1981							
NPD Onset							
Beta 1	—	—	—	—	+.12	—	
Beta 2	—	—	—	—	+.10	—	
Yes (17)	.164	25%	25%	10%	12%	25%	21%
No (139)	.158	17%	19%	9%	5%	21%	10%
PD Chronicity							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (16)	.925	51%	68%	64%	36%	84%	81%
No (124)	.628	58%	70%	51%	40%	76%	65%

*Not analyzed as a dependent variable.

Note.–Time 2 drinking variables were standardized residuals from regressing 1986 drinking variables on their 1981 equivalents. Each column shows multiple regression results for predictors of onset and chronicity of a specific Time 2 drinking variable. Predictors from the same equation appear in Tables 2 (sociodemographic), 3 (personality/life experience), and 4 (interim predictors). Beta 1 coefficients are from the first hierarchical step (including only Time 1 predictors) and Beta 2 coefficients are from the second hierarchical step (adding interim predictors). Underlined betas are significant at $p<.05$. With the exception of the far right-hand column (Problem Drinker Sample Criteria were not analyzed as a dependent variable), the absence of beta values indicates that the predictor was not significantly associated with that drinking variable in preliminary bivariate and multivariate winnowing analyses, and thus was not included in the final hierarchical equation. Weighted means and percentages are provided to illustrate the fit, or contrast, of simple bivariate comparisons with the more rigorous and conservative multiple regression analyses. Although means and rates are weighted, Ns are unweighted to show actual numbers of women in predictor categories. R^2 and R^2 change values for each equation and each hierarchical step are given at the bottom of each column, at the end of Table 4.

df = 1, p = .003) and 4.6 percent of 1981 NPDs age 50 or older ($\chi^2 = 7.54$, df = 1, p = .006).

- Remission of problem drinking was also most common among the youngest women; by 1986 only 27.4 percent of the 1981 PDs in the youngest age group still reported two or three problem drinking indicators, compared with 48.9 percent of 1981 PDs age 35 and older ($\chi^2 = 5.93$, df = 1, p = .015).
- Chronicity of problem drinking, on the other hand, was most likely among women age 35–49. Of the 1981 PDs in this age group, 57.2 percent continued to experience at least two problem drinking indicators in 1986, compared with 27.4 percent of women age 21–34 ($\chi^2 = 8.40$, df = 1, p = .004) and 35.6 percent of women age 50 or older ($\chi^2 = 1.84$, df = 1, p = .18; for 35 to 49-year-olds vs. all others, $\chi^2 = 7.97$, df = 1, p = .005).

Bivariate Relationships between Time 1 Predictors and Time 2 Drinking, and between Time 1 Drinking and Time 2 Conditions

Bivariate analyses consisted of a series of regression equations that used each Time 1 and interim predictor to predict the standardized residuals of each Time 2 drinking variable, and reciprocal analyses that used each Time 1 drinking variable to predict the standardized residuals of Time 2 or interim conditions corresponding to Time 1 predictors. These bivariate analyses showed many significant time-ordered relationships. Of 23 Time 1 variables, ten were significant predictors of Time 2 drinking variables among NPDs, and ten were significant predictors among PDs. Of ten interim variables, five were significant predictors of Time 2 drinking variables among NPDs, and six were significant predictors among PDs. In the other direction, of 19 Time 2 or interim conditions corresponding to Time 1 predictors, eight were significantly predicted by Time 1 drinking variables among NPDs, and 12 were significantly predicted by Time 1 drinking variables among PDs. Detailed results from the bivariate analyses are not presented here because of space limitations but are available upon request from the authors. Tables 2–4 include all Time 1and interim variables that significantly predicted any of the six Time 2 drinking variables among either PDs or NPDs in the bivariate analyses. Of the 33 potential

TABLE 3—1981 Personality and Life Experience Predictors of Five-Year Onset and Chronicity of Problem Drinking Indicators: Hierarchical Multiple Regression Coefficients with Unadjusted (Zero-Order) Weighted Means and Rates

	Time 2 (1986) Problem Drinking Indicators						
Time 1 (1981) Personality/Life Experience Predictors	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1+)	Problem Drinker Sample Criteria (% 1$^+$)
Depressive Episodes up to 1981							
NPD Onset							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Any (46)	.147	17%	20%	7%	3%	20%	11%
None (111)	.163	18%	19%	10%	6%	22%	12%
PD Chronicity							
Beta 1	—	—	+.11	+.17	+.04	+.10	
Beta 2	—	—	+.05	+.13	−.01	+.06	
Any (77)	.603	55%	74%	55%	45%	80%	65%
None (66)	.724	61%	66%	51%	34%	74%	70%
Anxiety, 1981							
NPD Onset							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (39)	.113	18%	27%	9%	5%	26%	9%
No (118)	.179	17%	16%	10%	5%	19%	12%
PD Chronicity							
Beta 1	−.20	—	—	−.16	—	—	
Beta 2	−.23	—	—	−.17	—	—	
Yes (55)	.565	57%	77%	48%	48%	84%	63%
No (88)	.718	58%	66%	56%	35%	73%	70%
Low Self-Esteem, 1981							
NPD Onset							
Beta 1	—	+.18	+.10	—	—	+.02	
Beta 2	—	+.16	+.10	—	—	+.01	
Yes (47)	.140	28%	26%	10%	3%	25%	11%
No (107)	.162	14%	18%	10%	6%	20%	11%
PD Chronicity							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (54)	.622	58%	68%	50%	29%	72%	63%
No (88)	.667	57%	71%	55%	46%	80%	70%
Nontraditional Gender Traits, 1981							
NPD Onset							
Beta 1	—	+.08	—	—	—	—	
Beta 2	—	+.06	—	—	—	—	
Yes (48)	.182	22%	21%	11%	4%	24%	14%
No (106)	.155	17%	20%	9%	6%	21%	10%
PD Chronicity							
Beta 1	+.26	+.12	+.14	+.14	—	+.13	
Beta 2	+.25	+.09	+.15	+.13	—	+.14	
Yes (47)	1.021	58%	75%	60%	44%	82%	77%
No (91)	.464	58%	67%	49%	36%	75%	62%
No. of Drugs Used up to 1981							
NPD Onset							
Beta 1	—	+.13	+.12	+.10	+.18	+.16	
Beta 2	—	+.10	+.14	+.08	+.14	+.15	
2$^+$ (26)	.196	23%	30%	10%	7%	30%	17%
0–1 (129)	.153	16%	18%	10%	5%	20%	10%
PD Chronicity[a]							
Beta 1							
Beta 2							
2$^+$ (45)	.875	59%	67%	57%	49%	74%	73%
0–1 (98)	.559	57%	71%	51%	36%	79%	64%
No. of Drugs Used in 1961							
NPD Onset[a]							
Beta 1							
Beta 2							
2$^+$ (4)[b]							
0–1 (144)	.165	17%	20%	10%	5%	22%	11%

(continued)

TABLE 3—Continued

Time 1 (1981) Personality/Life Experience Predictors	Time 2 (1986) Problem Drinking Indicators						
	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1^+)	Problem Drinker Sample Criteria (%1^+)
PD Chronicity							
Beta 1	+.16	—	—	—	+.14	+.11	
Beta 2	+.07	—	—	—	+.14	+.10	
2^+ (15)	1.543	72%	81%	62%	81%	81%	91%
0–1 (125)	.540	55%	68%	53%	35%	76%	65%
Premature Baby, up to 1981							
NPD Onset							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (10)	.117	0%	5%	0%	0%	5%	0%
No (145)	.162	19%	20%	10%	5%	22%	12%
PD Chronicity							
Beta 1	—	—	—	+.09	+.06	+.11	
Beta 2	—	—	—	+.08	+.03	+.10	
Yes (13)	.584	74%	82%	52%	54%	87%	73%
No (129)	.670	56%	69%	53%	38%	76%	67%
Miscarriage/Stillbirth, 1976–81							
NPD Onset							
Beta 1	—	+.05	—	—	—	—	
Beta 2	—	+.04	—	—	—	—	
Yes (6)	.082	62%	45%	0%	15%	45%	15%
No (149)	.161	16%	19%	10%	5%	20%	11%
PD Chronicity							
Beta 1	—	—	—	+.01	—	—	
Beta 2	—	—	—	+.03	—	—	
Yes (5)	.265	59%	80%	39%	39%	80%	39%
No (137)	.675	58%	70%	53%	40%	77%	68%
Infertility, up to 1981							
NPD Onset							
Beta 1	—	—	+.10	—	—	—	
Beta 2	—	—	+.11	—	—	—	
Yes (31)	.158	11%	18%	11%	8%	22%	14%
No (125)	.159	19%	20%	9%	4%	20%	10%
PD Chronicity							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Yes (18)	.916	78%	73%	49%	46%	73%	76%
No (125)	.625	55%	70%	54%	39%	78%	66%
Liberal Sexual Morality, 1981							
NPD Onset							
Beta 1	—	—	+.02	+.07	—	+.09	
Beta 2	—	—	+.02	+.14	—	+.11	
Yes (71)	.183	24%	35%	19%	10%	40%	22%
No (81)	.139	14%	10%	4%	2%	10%	5%
PD Chronicity							
Beta 1	—	—	—	+.10	—	—	
Beta 2	—	—	—	+.10	—	—	
Yes (95)	.755	63%	72%	58%	40%	79%	71%
No (47)	.475	43%	65%	45%	41%	74%	61%
Nontraditional Sexual Behavior, up to 1981							
NPD Onset							
Beta 1	+.11	+.13	+.10	—	—	+.08	
Beta 2	+.14	+.15	+.14	—	—	+.13	
Yes (95)	.176	24%	30%	13%	8%	32%	16%
No (46)	.146	8%	3%	6%	1%	6%	6%
PD Chronicity							
Beta 1	−.12	—	—	—	—	—	
Beta 2	−.13	—	—	—	—	—	
Yes (110)	.578	57%	74%	55%	37%	81%	67%
No (26)	.935	61%	59%	44%	47%	67%	67%

(*continued*)

TABLE 3—Continued

	Time 2 (1986) Problem Drinking Indicators						
Time 1 (1981) Personality/Life Experience Predictors	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1⁺)	Problem Drinker Sample Criteria (%1⁺)
Sexual Dysfunction, up to 1981							
NPD Onset							
Beta 1	—	—	—	—	—	—	
Beta 2	—	—	—	—	—	—	
Any (45)	.184	21%	22%	6%	5%	22%	10%
None (101)	.140	16%	19%	12%	5%	21%	12%
PD Chronicity							
Beta 1	—	—	+.19	+.19	+.18	+.29	
Beta 2	—	—	+.17	+.15	+.14	+.27	
Any (60)	.517	69%	81%	61%	52%	86%	75%
None (80)	.765	48%	59%	45%	29%	69%	59%
Heavy-Drinking Companions, 1981							
NPD Onset							
Beta 1	—	—	—	+.06	+.11	+.04	
Beta 2	—	—	—	+.07	+.11	+.01	
2^+ (26)	.171	19%	25%	13%	0%	22%	13%
0–1 (130)	.157	17%	19%	9%	6%	21%	11%
PD Chronicity							
Beta 1	—	—	—	−.26	—	—	
Beta 2	—	—	—	−.20	—	—	
2^+ (54)	.877	62%	73%	48%	37%	82%	65%
0–1 (88)	.550	56%	69%	56%	41%	76%	69%
Frequent-Drinking Partner, 1981							
NPD Onset							
Beta 1	—	—	—	—	−.17	—	
Beta 2	—	—	—	—	−.15	—	
Yes (22)	.171	19%	21%	9%	0%	21%	9%
No (135)	.157	17%	19%	10%	6%	21%	12%
PD Chronicity							
Beta 1	+.11	—	—	−.04	—	—	
Beta 2	+.14	—	—	−.07	—	—	
Yes (43)	.921	64%	69%	43%	39%	77%	62%
No (99)	.567	56%	71%	57%	40%	78%	70%

Note.—See Note, Table 2.

[a] In preliminary winnowing analyses, lifetime drug use was a stronger predictor of onset while current (1981) drug use was a stronger predictor of chronicity. Accordingly, only the lifetime use variable was included in the final regression equations for NPDs, and only the current use variable was used for PDs.

[b] Means and percentage rates are not provided for predictor categories with unweighted Ns less than 5.

predictors, only one—nontraditional feminine values—failed to predict any Time 2 drinking variables within either of the two subsamples.

Two variables often thought to be antecedents of problem drinking[16,17]—divorce or separation, and the "empty nest"—appeared to occur primarily after heavy or problem drinking in the present longitudinal bivariate analyses. The experience of a recent "empty nest" (last child leaving home in the past three years) did not predict Time 2 drinking behavior in either subsample, but among PDs, higher average consumption at Time 1 increased the likelihood that a respondent's last child would leave home during the three years prior to Time 2. Divorce and separation also occurred after rather than before heavy or problem drinking. Among NPDs, higher average consumption, heavy episodic drinking, and intoxication at Time 1 increased the likelihood of divorce or separation during the follow-up interval; similarly, among PDs, higher average consumption, intoxication, and PDI scores at Time 1 increased the chances of divorce or separation by Time 2. Contrary to expectations, being divorced or separated at Time 1 predicted lower levels of intoxication and lower PDI scores at Time 2 among PDs. We discuss additional bivariate relationships later in this paper, as an aid to interpreting multivariate findings.

Multivariate Prediction of Time 2 Drinking

Because some predictor variables were intercorrelated, it was important to examine the independent effects of each predictor, controlling for effects of all the others. Tables 2, 3, and 4 present the results of 12 unique hierarchical multiple regression equations predicting onset of problem drinking indicators among 1981 NPDs and chronicity of problem drinking indicators among 1981 PDs, using all predictors of a given Time 2 drinking variable surviving the winnowing process described above. Table 2 presents findings for Time 1 sociodemographic predictors; Table 3, findings for Time 1 personality and life-experience predictors; and Table 4, findings for all interim predictors. Although separated into three tables for convenience, the regression coefficients reflect the strength of each predictor when adjusted for *all* other predictors included in a given equation. Tables 2–4 also provide unweighted Ns, weighted means of

TABLE 4—Interim (1981–86) Sociodemographic, Personality, and Life Experience Predictors of Onset and Chronicity of Problem Drinking Indicators: Hierarchical Multiple Regression Coefficients with Unadjusted (Zero-Order) Weighted Means and Rates

1981–86 Interim Predictors	Time 2 (1986) Problem Drinking Indicators						
	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1⁺)	Problem Drinker Sample Criteria (%1⁺)
Became Unemployed, 1981–86							
NPD Onset							
Beta 2	—	+.08	+.12	—	—	—	
Yes (13)	.178	43%	68%	10%	0%	66%	10%
No (144)	.157	16%	16%	9%	5%	18%	11%
PD Chronicity							
Beta 2	+.26	—	—	—	—	—	
Yes (24)	.832	50%	82%	58%	33%	88%	67%
No (119)	.624	59%	68%	52%	41%	75%	67%
Became Employed Part time, 1981–86							
NPD Onset							
Beta 2	—	—	—	+.18	+.05	+.13	
Yes (34)	.225	22%	33%	27%	14%	33%	27%
No (123)	.143	17%	16%	9%	3%	18%	8%
PD Chronicity							
Beta 2	—	—	—	—	—	—	
Yes (30)	.572	63%	82%	48%	46%	84%	68%
No (113)	.683	56%	67%	55%	38%	75%	67%
Became Divorced/Separated, 1981–86							
NPD Onset							
Beta 2	—	—	+.02	—	+.01	+.01	
Yes (11)	.154	25%	44%	17%	17%	44%	25%
No (146)	.159	17%	17%	9%	4%	19%	10%
PD Chronicity							
Beta 2	—	—	−.15	—	−.24	−.15	
Yes (29)	1.028	48%	68%	53%	30%	72%	55%
No (114)	.582	60%	71%	53%	42%	78%	70%
Began Cohabiting, 1981–86							
NPD Onset							
Beta 2	+.18	—	+.16	—	—	+.18	
Yes (9)	.252	21%	46%	21%	6%	52%	21%
No (148)	.152	17%	18%	9%	5%	19%	11%
PD Chronicity							
Beta 2	+.13	—	+.10	—	—	—	
Yes (15)	1.104	58%	82%	65%	32%	82%	65%
No (128)	.613	58%	69%	52%	41%	77%	67%
Depressive Episodes, 1981–86							
NPD Onset							
Beta 2	—	—	—	+.23	+.16	+.12	
1⁺ (40)	.155	24%	27%	21%	13%	28%	25%
None (115)	.156	15%	17%	5%	2%	19%	6%
PD Chronicity							
Beta 2	—	+.10	+.19	+.08	+.24	+.10	
1⁺ (50)	.570	63%	81%	52%	54%	83%	64%
None (92)	.700	55%	64%	53%	32%	74%	68%
No. of Drugs Used, 1981–86							
NPD Onset							
Beta 2	—	+.08	—	—	+.07	—	
1⁺ (65)	.164	25%	20%	8%	8%	21%	11%
None (90)	.160	14%	20%	10%	3%	22%	12%
PD Chronicity							
Beta 2	—	—	—	+.12	—	+.05	
1⁺ (77)	.632	57%	75%	60%	45%	85%	72%
None (65)	.698	60%	64%	46%	34%	69%	63%
Premature Baby, 1981–86							
NPD Onset							
Beta 2	—	−.17	−.13	—	—	—	
Yes (2)[a]							
No (155)	.158	18%	20%	9%	5%	21%	11%

(*continued*)

TABLE 4—Continued

1981–86 Interim Predictors	Average Consumption (ounces ethanol/day)	Heavy Episodic Drinking (% any)	Intoxication (% any)	Problem Consequences (% any)	Dependence Symptoms (% any)	Problem Drinking Index (% 1⁺)	Problem Drinker Sample Criteria (%1⁺)
	Time 2 (1986) Problem Drinking Indicators						
PD Chronicity							—
Beta 2	—	—	—	−.04	−.18	—	
Yes (4)ᵃ							
No (139)	.670	58%	70%	55%	41%	77%	69%
Miscarriage/Stillbirth, 1981–86							
NPD Onset							
Beta 2	—	—	—	—	—	—	
Yes (1)ᵃ							
No (156)	.159	18%	20%	10%	5%	21%	11%
PD Chronicity							
Beta 2	—	—	—	−.12	—	—	
Yes (6)	.204	70%	70%	14%	28%	70%	28%
No (137)	.679	57%	70%	55%	40%	78%	69%
Infertility, 1981–86							
NPD Onset							
Beta 2	—	—	—	—	—	—	
Yes (6)	.205	22%	29%	35%	0%	47%	35%
No (151)	.156	17%	19%	9%	5%	20%	10%
PD Chronicity							
Beta 2	+.29	—	—	—	+.13	+.08	
Yes (15)	1.140	58%	84%	64%	69%	89%	69%
No (128)	.609	58%	69%	52%	37%	76%	67%
Sexual Dysfunction, 1981–86							
NPD Onset							
Beta 2	—	—	—	—	—	—	
Any (41)	.146	10%	21%	15%	7%	23%	16%
None (97)	.157	21%	20%	8%	4%	22%	10%
PD Chronicity							
Beta 2	—	−.16	—	+.10	—	—	
Any (43)	.650	45%	75%	57%	37%	81%	71%
None (93)	.623	67%	70%	52%	42%	76%	65%
1st-Step R^2, R^2 Change, and Total R^2 Values for Each Equation Predicting Onset among Nonproblem Drinkers							
1st-Step R^2	.02	.24***	.20***	.07	.09*	.13**	
R^2 Change	.03*	.04	.06	.09***	.04	.06	
Total R^2	.05	.28***	.25***	.16***	.13*	.19**	
1st-Step R^2, R^2 Change, and Total R^2 Values for Each Equation Predicting Chronicity among Problem Drinkers							
1st-Step R^2	.18***	.09*	.18**	.18*	.06	.20***	
R^2 Change	.14***	.03	.04	.05	.12***	.03	
Total R^2	.32***	.12*	.22**	.23*	.18***	.24***	

Note.—See Note, Table 2.
ᵃMeans and percentage rates are not provided for predictor categories with unweighted Ns less than 5.
(For R^2 values) *$p < .05$; **$p < .01$; ***$p < .001$.

average daily consumption, and weighted percentage rates on each of the Time 2 drinking measures for each predictor's primary category of effect. These unadjusted means and percentages from simple bivariate time-lagged comparisons are presented for descriptive purposes. However, for brevity, we limit our discussion to the more rigorous and conservative multiple regression analyses.

The numerous relationships summarized in Tables 2–4 mean that some relationships will be statistically significant simply by chance. For this reason, our discussion focuses primarily on those variables that predicted more than one Time 2 drinking variable, and on variables that showed consistent relationships to drinking within both NPD and PD samples or for both Time 1 and interim measures.

Time 1 vs. Interim Variables: Tables 2–4 show that both longer term (Time 1) and more recent (interim) influences are important for the longitudinal prediction of women's drinking. However, the time-order of interim variables and drinking changes cannot be specified precisely with the data analyzed here. Interim variables are most likely to be antecedents rather than consequences of drinking if they 1) are also significant as Time 1 predictors, and/or 2) are not consequences of increased drinking or drinking problems in the two-way bivariate analyses reported earlier.

Predictors of Onset: As shown in Table 1, of 153 drinking women with no indicators of problem drinking in 1981, by 1986 17 (11 percent) had developed at least one indicator, and seven (4 percent) reported two or three indicators. Tables 2–4 show that the most consistent predictors of onset of heavier drinking or adverse drinking consequences were younger age, cohabiting at Time 1 or during the follow-up interval, lifetime use of drugs other than alcohol, and depressive episodes during the follow-up interval. Cohabiting was significant as both a Time 1 and an interim predictor and predicted the largest number of Time 2 drinking variables (average consumption, heavy episodic drinking, intoxication, and PDI). Younger age predicted increased intoxication, and in equations without interim variables also predicted increased heavy episodic drinking and PDI scores, while the number of drugs used up to 1981 predicted increased intoxication and PDI scores and, in an equation without interim variables, increased alcohol dependence symptoms. Two Time 1 predictors—nontraditional sexual behavior and low self-esteem—each increased the likelihood of heavy episodic drinking at Time 2.

Predictors of Chronicity: Of the 140 1981 PDs for whom complete data are available, 51 (36.5 percent) continued to report two or three problem drinking indicators in 1986, while 43 (31 percent) reported only one indicator and 46 (33 percent) no longer reported any indicators. As shown in Table 3, the most consistent predictor of persistent problem drinking was Time 1 sexual dysfunction, which predicted Time 2 intoxication, drinking problems, alcohol dependence symptoms, and PDI scores. Depressive episodes during the follow-up interval predicted continued intoxication and dependence symptoms, and in an equation without interim variables, Time 1 depression predicted continued drinking problems.

Five other variables predicted that PDs would drink more heavily at Time 2: interim unemployment and infertility, and Time 1 part-time employment, nontraditional gender traits, and frequent-drinking partner. PDs who had never married by Time 1 were more likely to report Time 2 drinking problems and (in equations excluding interim variables) to report more Time 2 intoxication and higher PDI scores. Use of drugs other than alcohol at Time 1 increased the likelihood of continued alcohol dependence symptoms and (in the equation excluding interim variables) heavier drinking.

Predictors of Remission: Although the analyses reported here were not designed to study remission of problem drinking, some variables that were expected to predict increased drinking had opposite effects in the longitudinal analyses (indicated by negative beta coefficients in Tables 2–4). For the most part, these were isolated effects, involving only single dependent variables. Consistent with the bivariate effects of Time 1 divorce, which reduced Time 2 intoxication and PDI scores among problem drinkers, becoming divorced or separated during the follow-up interval decreased the level of Time 2 alcohol dependence symptoms reported by problem drinkers.

Discussion

Patterns of Change

As in earlier reports based on retrospective[11] and longitudinal[14,18] data, women's drinking behavior in this study showed considerable change over a five-year period. Eleven percent of women with no signs of problem drinking in 1981 reported at least one problem drinking indicator in 1986, and 33 percent of the 1981 problem drinkers were completely free of problems five years later. This fluctuation may in part reflect the relatively mild definition of problem drinking used in this study, in contrast to more stable and interrelated alcohol problems associated with severe problem drinking or clinical alcohol dependence. However, our findings may also indicate that frequently drinking problems among women in the general, nonclinical population are sporadic or intermittent, possibly related to shifts in roles, contexts, and other circumstances in women's lives.

Age as a Mediator of Drinking Change

Women's problem drinking appears to change more in youth than later in life. Younger age significantly predicted the onset of intoxication among NPDs and significantly predicted reductions in average consumption among PDs. Women age 21–34 were more likely than older women to show both onset and remission of problem drinking indicators, while chronicity of problem drinking was greatest among women age 35–49.

These patterns are consistent with previous findings of higher rates of heavy episodic drinking, intoxication, and drinking problems among younger than among older women;[4] with data showing greater remission of drinking problems among younger than among older men;[19] and with findings of greater chronicity among middle-aged than among younger or older problem drinking women.[20] Younger women's greater movement both into and out of risky drinking behavior may relate to fluctuations in drinking contexts and drinking partners within this age group, as well as to transitions in employment, marital, and childbearing roles.[10,21]

Nontraditional Life-style and Onset

Nonproblem drinking women who reported nontraditional sexual behavior (premarital sexual relations and/or masturbation before age 21) at Time 1 and those who cohabited at Time 1 were more likely than other NPDs to report heavy episodic drinking at Time 2, and those beginning cohabitation during the follow-up interval were more likely to report other problem drinking indicators. Nontraditional sexual behavior and cohabitation may be indicators of a life-style associated with greater freedom from the traditional moral constraints that have restricted both sexual and drinking behavior, especially in women.[9,22] This greater freedom from conservative moral constraints may carry with it increased drinking opportunities and more permissive drinking norms that can heighten the risks of excessive drinking behavior. In addition, premarital and cohabiting relationships, lacking institutional protection or support, may involve stressful uncertainties that can lead to stress-medicating alcohol consumption.

Sexual Dysfunction and Chronicity

The best single predictor of chronicity was sexual dysfunction, which predicted continued intoxication, drinking problems, alcohol dependence symptoms, and PDI scores. This finding may reflect a tendency of problem drinking women to self-medicate sexual difficulties with alcohol, given prevailing cultural beliefs that drinking reduces sexual inhibitions and facilitates sexual pleasure.[9,23,24] Since heavy alcohol consumption has detrimental effects on physiological sexual functioning,[25] a self-reinforcing cycle may occur in which heavy drinking becomes both cause and consequence of sexual dysfunction. Our findings suggest a need to address issues of sexuality and sexual dysfunction in the treatment and recovery of alcoholic women, and a need to assess drinking behavior among women presenting with sexual dysfunction—needs also noted by recent clinical writers.[26–28] Because recent research on sexuality and drinking has focused mainly on women, it will be important to determine in future research the extent to which sexual experience and sexual dysfunction also influence drinking and problem drinking in men.

Role Deprivation and Women's Drinking

Other predictors of chronicity included never having been married, being employed part time at Time 1, and becoming unemployed during the follow-up interval. Part-time employment during the follow-up interval also predicted onset of drinking problems among 1981 NPDs, as did cohabiting. We have suggested elsewhere that a lack or loss of stable, full-time employment or marital roles (e.g., being unmarried, unemployed, or employed part time) may constitute "role deprivation."[10] Role deprivation may increase the risk of alcohol abuse by reducing women's self-esteem and feelings of social worth, and by reducing contact with role partners who could provide social support and feedback about excessive drinking behavior. Role deprivation as a risk factor for the onset and chronicity of problem drinking in women contrasts with earlier hypotheses regarding role conflict or role overload as causes of women's problem drinking[29]† but is consistent with other evidence linking multiple roles to better health outcomes.[30,31]

Other Drug Use and Women's Drinking

In preliminary bivariate analyses, different Time 1 drug use variables predicted Time 2 drinking for NPDs as compared with PDs: the number of different types of drugs used *up to* 1981 predicted Time 2 alcohol dependence symptoms and PDI scores among NPDs, while the number of different types of drugs *currently* used in 1981 predicted Time 2 consumption, dependence symptoms, and PDI scores among PDs. Similarly, in the multivariate analyses reported in Table 3, drug use up to 1981 increased the likelihood of subsequent intoxication and higher PDI scores (as well as dependence symptoms in the equation omitting interim variables) among NPDs, while current drug use in 1981 predicted continued dependence symptoms (and, in the equation without interim variables, higher average consumption) at Time 2 among PDs.

These patterns suggest that the relationships between women's drinking and their use of other drugs may differ at different stages of problem drinking. The onset of problem drinking may be facilitated by a woman's long-term tendency to use various psychoactive drugs—perhaps in an alternating pattern over time—to feel better, to have a good time, or to cope with problems.[8] Once drinking problems have developed, the *concurrent* use of alcohol and other drugs may have synergistic effects—both physiological and behavioral—that increase the risks of continued or worsened alcohol abuse.

Unexpected Findings

From previous cross-sectional findings[10,29] and clinical-retrospective reports,[16,17] we expected that divorce or separation and children's departure from home would predict the onset and/or chronicity of women's problem drinking. However, in the longitudinal bivariate analyses both of these experiences were more likely to follow than to precede problem drinking, and in multivariate analyses, becoming divorced or separated during the follow-up interval reduced the risk of Time 2 alcohol dependence symptoms among PDs. Causes and effects may be more complex than the simple time sequences here can reveal. For example, it is possible that a troubled marriage (perhaps involving sexual dysfunction or a problem-drinking spouse) may lead a woman into problem drinking, which then remits when the marital distress is relieved by divorce or separation. A more refined and focused analysis is needed to distinguish the effects of two different types of role relationships: positive, gratifying role relationships, whose loss may lead to increased drinking, and negative, frustrating role relationships, whose termination may result in reduced distress and decreased drinking.

Different Predictors of Different Drinking Behaviors

In the results presented here, different Time 1 and interim variables predicted different Time 2 drinking variables. Furthermore, these links between predictor and drinking variables were sometimes different for PDs and NPDs. We are clearly not dealing with a unitary entity—"problem drinking"— but rather with multiple aspects of risky drinking behavior and drinking consequences, which may be influenced differently by different characteristics of the drinker and her social environment.

Despite this complexity, a few generalizations are possible. Predictors of drinking patterns (average consumption, heavy episodic drinking, and intoxication) are more often situational variables (e.g., cohabiting, unemployment, frequent-drinking partner) or life-style variables (e.g., nontraditional sexual behavior, nontraditional gender traits), whereas predictors of adverse drinking consequences (drinking problems, alcohol dependence symptoms) include more individual psychological variables (in particular, depression and sexual dysfunction). Psychological variables are also somewhat more prominent predictions of chronicity than of onset. These patterns suggest that the factors that lead a woman into high-risk drinking are not the same as the factors that sustain or exacerbate problem drinking. Participation in a nontraditional life-style, involving greater freedom from conventional moral constraints on women's drinking and sexual behavior, may entail both drinking opportunities and stressful uncertainties that can increase a woman's risk of hazardous drinking behavior. Whether problematic drinking behavior continues may depend on other factors, including the extent to which a woman uses alcohol to deal with personal or interpersonal difficulties such as sexual dysfunction, depression, or role deprivation. Delineating more fully the predictors of change at these different stages of problem drinking, for specific subgroups of women (e.g., by age), would allow primary and secondary prevention efforts to be targeted more precisely to the characteristics of the drinker, her social environment, and the extent to which she has progressed into problem drinking behavior. ☐

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APPENDIX— Personality, Sexuality, and Drinking Variables*

Personality

Depressive Episodes, up to 1981: Number of depressive episodes (two or more weeks of depressed mood and three or more depressive symptoms, occurring within the same month; from Diagnostic Interview Schedule[32]) up to 1981 (0, 1, 2[†]).

Depressive Episodes, 1981–86: Presence of any depressive episodes (DIS criteria) in the five years before 1986 survey (yes/no).

Anxiety, 1981: Whether respondent considers self a nervous or anxious person at time of 1981 survey (yes/no).

Anxiety, 1986: Whether respondent considers self a nervous or anxious person at time of 1986 survey (yes/no).

Low Self-Esteem, 1981: With reference to 1981 self-description on seven gender-typed traits (Personal Attributes Questionnaire[33]), in how many ways respondent would like to be different (two levels: some or many ways vs. a few or none).

Low Self-Esteem, 1986: As measured in 1981 (four levels).

Nontraditional Gender Traits, 1981: Nine-level index based on two traditionally feminine traits—devotion to others, understanding of others (Personal Attributes Questionnaire[33])—dichotomized at most nontraditional quartile.

Nontraditional Gender Values, 1981: Eleven-level index based on two traditionally feminine values—marriage and parenthood[34]—dichotomized at most nontraditional quartile.

Nontraditional Gender Values, 1986: As measured in 1981.

Sexuality

Liberal Sexual Morality, 1981: Moral approval of adult premarital sex with love, in 1981 (four levels).[22]

Liberal Sexual Morality, 1986: As measured in 1981.

Nontraditional Sexual Behavior up to 1981: Index based on having had premarital sexual relations and/or a self-induced sexual climax before age 21, reported in 1981 (three levels). The index label "Nontraditional Sexual Behavior" refers to traditional sociocultural norms disapproving of both masturbation and premarital sex (particularly for women), and is not meant to imply that either behavior is presently nonconventional (i.e., exhibited only by a "deviant" minority of women). There is considerable evidence that traditional norms of this sort can continue to affect behavior and associated moral judgments even when behavioral violations and attitudinal exceptions achieve a modal, perhaps even a majority, level in a statistical sense.[35]

Sexual Dysfunction up to 1981: Index based on having experienced, up to 1981, lifetime lack of sexual interest, vaginismus, lifetime lack of orgasm, or unreliable (<50 percent of occasions) orgasm (four levels).[9] Questions based on Kaplan's classification of female sexual dysfunctions;[36,37] some questions adapted from Diagnostic Interview Schedule.[32] Male respondents answered parallel questions about male sexual dysfunctions.

Sexual Dysfunction, 1981–86: Index based on having experienced, between 1981 and 1986, lifetime lack of sexual interest, vaginismus, lifetime lack of orgasm, or unreliable (<50 percent of occasions) orgasm (four levels).

Drinking and Drinking Consequences

Average Consumption: Mean ounces of ethanol per day in last 30 days, estimated by calculating separately and summing for wine, beer, and liquor:

- (usual number of drinking days per month) × (usual number of drinks per typical drinking day) ×
- (size of drink: wine = 4 oz.; wine coolers = 5 oz. [1986]; beer = 12 oz. or 16 oz.; liquor = self-reported ounces per drink) ×
- (ethanol content: regular wine = 12 percent [1981], 11 percent [1986]; fortified wine = 18 percent; wine coolers = 12 percent [1986]; regular beer = 4 percent; malt liquor = 5 percent [1986]; low-calorie beer = 3 percent [1986]; low-alcohol beer = 2 percent [1986]; liquor = 41 percent [1981], 40 percent [1986])/30 days.

Heavy Episodic Drinking: Frequency, in past 12 months, of having six or more drinks of wine, beer, or liquor in a single day (three levels: never in past 12 months; one–three days or four–seven days in past 12 months; eight to 11 days in past 12 months to five or more days per week).

Intoxication: Frequency, in past 12 months, of drinking enough to feel drunk—where drinking "noticeably affected your thinking, talking, and behavior" (three levels: never in past 12 months; one–three days in past 12 months; four days in past 12 months to five or more days per week).

Problem Consequences: Number of drinking-related problems experienced in past 12 months, from a list of nine problems (see text, "Drinking Variables"; three levels: 0, 1, 2 or more).

Alcohol Dependence Symptoms: Number of alcohol dependence symptoms experienced in past 12 months, from a list of five symptoms (see text; three levels: 0, 1, 2 or more).

Problem Drinking Index (PDI): Index summing the occurrence in the past 12 months of 1) any intoxication, 2) any problem consequence, and 3) any alcohol dependence symptom (range: 0–3). Not to be confused with subsampling criteria for 1981 problem drinkers (at least two of the following: one or more ounces ethanol per day; one or more problem consequences in past 12 months; one or more alcohol dependence symptoms in past 12 months).

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*Definitions of other variables are available upon request from the authors.

Race and Weight Change in US Women: The Roles of Socioeconomic and Marital Status

ABSTRACT

Background. The prevalence of overweight among Black women in the US is higher than among White women, but the causes are unknown.

Methods. We examined the weight change for 514 Black and 2,770 White women who entered the first Health and Nutrition Examination Survey (1971–75) at ages 25–44 years and were weighed again a decade later. We used multivariate analyses to estimate the weight-change effects associated with race, family income, education, and marital change.

Results. The mean weight change was greater for the Black women than the White women. Adjustments for height, duration of follow-up, baseline body mass index, and multiple demographic, social, and behavioral variables did not reduce this mean Black-White difference.

Conclusions. Among US women, Black race is independently associated with a reduced likelihood of major weight loss, but not with major weight gain. Women at greatest risk of weight gain are those with education below college level, those entering marriage, and those with very low family income. (*Am J Public Health* 1991;81:319–323)

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Introduction

Cross-sectional surveys among United States adults have demonstrated that Black women have a higher prevalence of overweight than White women.[1,2] Overweight in US women is directly associated with low socioeconomic status.[3–6] Despite the association between Black race and low income or low education, controlling for socioeconomic status has not eliminated the overweight prevalence differences between Black women and White women.[1]

Prevalence alone does not explain the reasons for these observed associations. To understand the origin of overweight, we wondered whether race or socioeconomic factors during adulthood were independently associated with a woman's likelihood of gaining weight and whether marital status was involved (since this factor appears to be associated both with weight status[5] and with race).

Rac[illegible]cioeconomic status, or marital stat[illegible]ht contribute to overweight prevalence either by promoting weight gain or by inhibiting weight loss. To clarify the circumstances that led to the current weight distribution, we analyzed the mean weight changes, the major weight gains, and the major weight losses of a nationally representative prospective cohort of adult US women that was followed up over approximately a 10-year interval.

Methods

Study Population

This report analyzes public-use computer tapes containing the data from the First National Health and Nutrition Examination Survey[7,8] (NHANES-I) and the NHANES-I Epidemiologic Follow-up Study.[9] The subjects of NHANES-I, a probability sample of the US civilian, noninstitutionalized population resident in the contiguous 48 states, were initially interviewed and weighed in 1971–75. We limited our analysis to those who entered at ages 25–44 because these younger adult subjects had a greater risk of weight gain than older women.[10]

The initial NHANES-I population sample used for this analysis included 3,589 White women and 735 Black women between the ages of 25 and 44. (Seventy-two women in this age range with other racial designations are not included in this report.) Between 1982 and 1984 the NHANES-I Epidemiologic Follow-up Study successfully traced 3,210 (89 percent) of these White women and 621 (84 percent) of these Black women.[11] We excluded from this cohort women who had died since their initial examinations (50 Whites, 33 Blacks) and women for whom a valid, nonpregnant weight was not available at either baseline or follow-up (390 Whites, 74 Blacks). Thus, the 3,284 subjects included in this study of weight change represent 77 percent of the White women and 70 percent of the Black women initially enrolled in the NHANES-I cohort.

The mean duration of the follow-up interval was 10.1 ± 1.2 (SD) years.

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Definitions of Weight Change

Baseline measurements of height and weight were obtained under controlled conditions, with the subject wearing only disposable paper uniforms and foam rubber slippers. The follow-up weight was obtained in the subject's home after she removed her shoes and articles of heavy clothing. These follow-up values were corrected for the weight of the subject's indoor clothing by subtracting 1.6 kg from the measured weight.[10]

For each subject, weight change was categorized as either *major weight gain* (an increase of 13.0 kgs or more), *major weight loss* (a decrease of 7.0 kgs or more), or *mid-range weight change* (weight changes > −7 kgs but < +13 kgs).

Statistical Analysis

Considering weight change as a continuous variable, we used multiple linear regression models to estimate the effects associated with race, family income, education, and marital change. Our simple model adjusted each of these variables only for age, height, and duration of follow-up. Our fully adjusted model included adjustments for race, family income, education, marital change, age, height, duration of follow-up, body mass index (BMI, kg/m^2) at baseline, smoking, physical activity, parity, and rural/urban background (see Appendix for variable definitions).

Considering weight change as a categorical variable, we used multiple logistic regression analysis (employing the SAS procedure PROC LOGIST[12]) to estimate the odds ratio of either major weight gain or major weight loss for the various categories of race, family income, education, and marital change. Simple and fully adjusted models were developed as described above. For these analyses, the mid-range outcome of weight change was considered the "non-disease" group. Logistic regression analyses excluded 19 subjects with various unknown values.

We also performed multiple linear and logistic regression analyses stratified by overweight status at baseline. The overweight group at baseline (BMI ≥ 27.3) included 221 Blacks and 547 Whites; the group not overweight at baseline (BMI < 27.3) included 293 Blacks and 2,223 Whites.

Results

Mean Changes in Weight

The mean (±SD) change in weight was greater for Black women (3.8 ± 9.6 kgs) than for White women (2.8 ± 8.0) (difference = 1.0 kgs [95% confidence interval = 0.1, 1.9]). Blacks had a significantly wider variance of this weight-change variable (p = .0001, F-test for inequality of the variances). Adjustments for age, height, duration of follow-up, and other variables (Table 1) did not reduce this Black-White difference in mean weight change. Fully adjusted analyses stratified by overweight status at baseline showed that the Blacks' excess mean weight gain was 3.7 kgs (95% CI = 1.7, 5.8) among women who were initially overweight; among women not initially overweight, the Blacks' excess was only 0.8 kg (95% CI = −.1, 1.6).

The fully adjusted multiple linear regression model (Table 1, right column) demonstrated that women with only a 12th grade education had significantly greater weight gain compared to women who had gone beyond the 12th grade. When compared with women who were consistently married, women who became married during the 10-year interval experienced a greater weight gain, and women whose marriage ended experienced a relative weight loss.

Risk Factors for Major Weight Gain

Black women experienced a higher crude incidence of major weight gain (13.4 percent) than did the White women (7.7 percent).

TABLE 1—Effect of Race, Family Income, Educational Attainment, and Marital Change on Mean Weight Change, by Multiple Linear Regression Modeling; US Women aged 25–44 at Baseline, NHANES-I Baseline (1971–75) and NHANES-I Follow-up (1982–84) [n = 3284]

Variables	Increment in the Mean Weight Change in Kilograms (95% confidence interval)			
	Adjusted for Age, Height, and Duration of Follow-up		Fully Adjusted Model*	
Race				
White	0.0	—	0.0	—
Black	+1.0	(+.2, +1.8)	+1.7	(+0.8, +2.5)
Family income, both interviews				
Adequate	0.0	—	0.0	—
Moderately low	−0.2	(−1.0, +0.7)	−0.1	(−0.9, +0.8)
Very low	−0.2	(−1.0, +0.6)	−0.4	(−1.3, +0.6)
Unknown	−0.1	(−1.1, +0.9)	−0.2	(−1.2, +0.8)
Education (highest grade)				
> 12th	0.0	—	0.0	—
12th	+0.6	(−0.1, +1.3)	+0.9	(+0.2, +1.6)
< 12th	+0.2	(−0.6, +1.0)	+0.7	(−0.1, +1.6)
Unknown	−1.0	(−4.7, +2.8)	+0.2	(−3.6, +4.0)
Marital change				
Consistently married	0.0	—	0.0	—
Marriage ended	−1.2	(−2.1, −0.3)	−1.0	(−1.9, −0.2)
Became married	+2.3	(+0.9, +3.8)	+2.1	(+0.6, +3.4)
Stayed unmarried	−0.1	(−0.8, +0.7)	+0.3	(−0.7, +1.2)
Unknown	−6.4	(−16, +2.9)	−5.4	(−15, +4.0)

*Includes race, family income, education, marital change, age, height, duration of follow-up, BMI at baseline, smoking, physical activity, parity, and rural/urban background.

TABLE 2—Effect of Race, Family Income, Educational Attainment, and Marital Change on the Risk of Major Weight Gain (MWG), by Multiple Logistic Regression; US Women Aged 25–44 at Baseline Who Experienced MWG (n = 281) or Mid-range Weight Change (n = 2,759) between NHANES-I Baseline (1971–75) and NHANES-I Follow-up (1982–84)

	Estimated Odds Ratios for MWG (95% confidence interval)			
Variables	Adjusted for Age, Height, and Duration of Follow-up		Fully Adjusted Model*	
Race				
White	1.00	—	1.00	—
Black	1.79	(1.33, 2.41)	1.21	(0.85, 1.71)
Family income				
Adequate	1.00	—	1.00	—
Moderately low	1.60	(1.12, 2.29)	1.38	(0.94, 2.04)
Very low	2.08	(1.52, 2.85)	1.71	(1.15, 2.55)
Unknown	1.16	(0.73, 1.87)	1.21	(0.74, 1.98)
Education (highest grade)				
> 12th	1.00	—	1.00	—
12th	1.46	(1.05, 2.04)	1.19	(0.84, 1.68)
< 12th	1.58	(1.10, 2.27)	0.91	(0.60, 1.39)
Unknown	1.98	(0.43, 9.07)	0.83	(0.17, 4.10)
Marital change				
Consistently married	1.00	—	1.00	—
Marriage ended	0.90	(0.60, 1.35)	0.80	(0.52, 1.23)
Became married	1.55	(0.92, 2.62)	1.53	(0.88, 2.65)
Stayed unmarried	1.28	(0.92, 1.78)	1.00	(0.65, 1.52)

*Includes race, family income, education, marital change, age, height, duration of follow-up, BMI at baseline, smoking, physical activity, parity and rural/urban background.

When the logistic regression model was adjusted only for age, height, and duration of follow-up (Table 2, left column), Black race was significantly associated with major weight gain. Both low family income and low education were also associated with major weight gain (Table 2, left column).

However, in the fully adjusted model (Table 2, right column), Black race was only weakly associated with major weight gain. Stratification by overweight status at baseline did not alter this negative finding. In the fully adjusted model the strongest risk factors associated with major weight gain were very low family income (OR = 1.71) and becoming married during the follow-up interval (OR = 1.53).

The risk of major weight gain was also independently associated with being overweight at baseline in our fully adjusted model. Compared with women who entered the cohort in the lowest BMI stratum (BMI < 19.1), those in successively higher strata of baseline BMI had odds ratios for major weight gain of 0.64 (95% CI = 0.38, 1.07), 1.32 (0.79, 2.19), 2.23 (1.30, 3.82), and 2.26 (1.27, 4.04). If the larger multivariate model excluded adjustment for baseline BMI, the association between Black race and major weight gain yielded OR = 1.41 (95% CI = 1.00, 1.99).

Risk Factors for Major Weight Loss

Black women also experienced a higher crude incidence of major weight loss (8.8 percent) than did the White women (6.5 percent). However, the major weight loss logistic regression model, adjusting for age, height, and duration of follow-up (Table 3, left column), demonstrated that the odds ratio for Black race was only 1.35 (95% CI = 0.95, 1.92). After fully adjusting for other variables (Table 3, right column) Black race had an inverse (protective) association with major weight loss (OR = 0.64). Fully adjusted analyses stratified by baseline BMI indicated that this inverse association was limited to women who were overweight at baseline (OR = 0.53 [95% CI = 0.32, 0.89]) and was not observed among women who were not initially overweight (OR = 1.08 [95% CI = 0.51, 2.30]).

Very low family income was directly associated with the risk of major weight loss in the fully adjusted model (OR = 1.86).

Discussion

Several methodologic or interpretive issues should be considered when reviewing the weight-change experience of this large, representative, prospective cohort.

Approximately one-fourth of the population originally enrolled in NHANES-I was omitted from the analyses because of loss to follow-up or lack of a valid weight measurement. The effect of their missing data is unknown. However, any substantial bias would most likely have been due to diseases which might have caused these women both to be missing from the cohort and to have gained either more or less weight than those who participated fully. For these missing, hypothetically diseased, women to have changed substantially our results, they would have had to experience an extraordinary degree of consistently increasing weight (e.g. edema or ascites) or consistently decreasing weight (e.g. cachexia). This is unlikely since the enrolled cohort was relatively young and during the 10-year interval only a small proportion would have been expected to acquire a major, chronic disease. Systematic biases due to other causes seem even less likely.

Our principal outcome events, major weight gains and losses, were determined by the difference between weight measurements made at only two points widely separated in time. Fluctuations in weight that may have occurred during the decade of follow-up are not reflected in our data. Hence our case definitions for both major weight gain and major weight loss probably failed to include everyone who had a major weight change between baseline and follow-up exams. Semi-annual weights obtained in a four-year Dutch study suggest that overweight women and women with the highest rates of weight gain or weight loss are also the women who experience the widest weight fluctu-

TABLE 3—Effect of Race, Family Income, Educational Attainment, and Marital Change on the Risk of Major Weight Loss (MWL), by Multiple Logistic Regression; US Women Aged 25–44 at Baseline Who Experienced MWL (n = 225) or Mid-range Weight Change (n = 2,759) between NHANES-I Baseline (1971–75) and NHANES-I Follow-up (1982–84)

	Estimated Odds Ratios for MWL (95% confidence interval)			
Variables	Adjusted for Age, Height, and Duration of Follow-up		Fully Adjusted Model*	
Race				
White	1.00	—	1.00	—
Black	1.35	(0.95, 1.92)	0.64	(0.41, 0.97)
Family income, both interviews				
Adequate	1.00	—	1.00	—
Moderately low	1.69	(1.13, 2.52)	1.25	(0.79, 1.97)
Very low	2.43	(1.73, 3.42)	1.86	(1.18, 2.95)
Unknown	1.41	(0.86, 2.29)	1.73	(1.01, 2.96)
Education (highest grade)				
> 12th	1.00	—	1.00	—
12th	1.45	(0.99, 2.12)	0.92	(0.61, 1.41)
< 12th	1.86	(1.24, 2.78)	0.69	(0.42, 1.12)
Unknown	2.76	(0.60, 12.8)	0.97	(0.17, 5.51)
Marital change				
Consistently married	1.00	—	1.00	—
Marriage ended	1.57	(1.08, 2.38)	1.18	(0.76, 1.83)
Became married	0.23	(0.06, 0.93)	0.25	(0.06, 1.05)
Stayed unmarried	1.16	(0.80, 1.69)	0.74	(0.45, 1.21)

*Includes race, family income, education, marital change, age, height, duration of follow-up, BMI at baseline, smoking, physical activity, parity, and rural/urban background.

ations.[13] Thus, our observed incidence rates for major weight change likely represent low estimates for the occurrence of major weight gain or major weight loss over a 10-year period.

After adjusting for multiple variables, Black women had a greater increase in mean weight compared to White women in this cohort (Table 1). This finding is consistent with US prevalence data. However, after full multivariate adjustments we found that Black women were not significantly more likely than White women to experience a major weight gain (Table 2). The racial effect on mean weight change could readily be viewed as a result of the Black women's decreased tendency to lose weight (Table 3). Our analyses stratified by baseline overweight status demonstrated that it was only among women who were overweight at baseline that the Blacks showed a clear excess of mean weight gain and a protective effect against major weight loss.

This reduced likelihood of weight loss among overweight Black women deserves further study. It could reflect acquired cultural factors (e.g. specific dietary exposures, perceptions of ideal body size) that may have made Black women less able or less motivated than White women to lose weight. Genetic factors may also play a role. Our data provide no basis for choosing among these explanations. As with any studies that collect data on race,[14] the NHANES-I criterion for being Black (or White) may have historical, social, or cultural significance that exceeds any clear genetic meaning.

We noted that the risks of both major weight gain and major weight loss in the NHANES-I follow-up cohort were directly associated with high BMI at baseline. Similar observations have been made previously in other female populations from the US[15] and Europe.[13,16] Since the Black women in our study were more overweight at baseline than were the White women, preexisting weight status was a potential confounder of the relationship between women's weight change and race. If the baseline BMI was not taken into account, multiple adjustments for current social, demographic, and behavioral factors reduced the Blacks' odds ratio for major weight gain from 1.79 to 1.41. Including adjustment for baseline BMI (along with the other variables) further reduced the major weight gain odds ratio to 1.21. It is possible that our adjustment for baseline BMI served as a surrogate adjustment for the prior weight-related experiences of cohort members before they entered the follow-up study. If low income and low education are associated with increased mean or major weight gains, then these circumstances common among US Black women before they entered NHANES-I may have explained their having baseline BMIs that were higher than those of the White women.

The serious health risks associated with adult overweight and the low success rates associated with its treatment suggest that we must develop a public health strategy for the prevention of weight gain among adults. Our findings indicate that women in greatest need of help in preventing weight gain are those with education below college level, those with low family incomes, and those who become married. Black race does not appear to be an independent adult risk factor for weight gain. Future research should address the mechanisms by which the diet and social stresses of women with low socioeconomic status may influence their weight changes. Studies of eating practices and physical activity changes associated with entering marriage might likewise contribute to the prevention of adult weight gain. □

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APPENDIX

Definitions of Other Variables

Race was classified by interviewer observation as "White, Negro or other"; if the appropriate category could not be marked by observation, then the respondent was asked her race. (Hispanics not regarded as "Negro" were included with "White" unless definitely known to be American Indian or other non-White race, in which case they were excluded from this analysis.)

The baseline interview also categorized the subject's *educational level* as the "highest grade of regular school ever attended."

The *family income* variable used categorical interview information collected both at NHANES-I baseline and at follow-up to classify women as having very low, moderately low, or adequate levels of family income across the ten-year interval:

	Family Income at Follow-up (1982–84)		
	< $15,000	15,000–$19,999	$20,000+
Family Income at Baseline *(1971–75)*			
$10,000 +	Adequate	Adequate	Adequate
$7,000–$9,999	Mod. Low	Mod. Low	Adequate
< $7,000	Very Low	Mod. Low	Adequate

Based on contemporaneous median family incomes in the U.S.,[17] women in the "very low" income level had family incomes below about 59% of median family incomes for both time periods. Women in the "moderately low" income level had family incomes below about 82 percent of median family incomes (but not repeatedly below about 59 percent of median) for both time periods.

Marital change was defined as consistently married, marriage ended, became married, or stayed unmarried, depending on whether the subject reported being married or not at baseline and at follow-up. Women who might have become divorced and remarried during the follow-up interval were included within the "consistently married" category.

Age at baseline was stratified by five-year intervals.

Height and *duration of follow-up* were treated as continuous variables.

The subjects' *weight status at baseline*, as estimated by body mass index (BMI, kg/m^2), was divided into five categories with break points at BMIs of 19.1, 23.0, 27.3, and 32.3.

Among the additional variables considered as possible confounders, *smoking status* was defined at follow-up as never smoked, continuing smoker, and ex-smoker. Self-described recreational and nonrecreational *physical activity*, determined at both baseline and follow-up, was defined in three levels as consistently low, moderate or inconsistent, and consistently high. *Parity* at the time of follow-up was stratified as 0, 1-2, 3-4, and 5+. *Rural/urban background* was determined by the subject's response at follow-up to the question "Would you say that you have lived most of your life in a rural area, or the city or in the city suburbs?"

Gender Differences in Cigarette Smoking and Quitting in a Cohort of Young Adults

Phyllis L. Pirie, PhD, David M. Murray, PhD, and Russell V. Luepker, MD

ABSTRACT

Background. Smoking among young women is associated with a variety of negative health outcomes. Gender specific influences on smoking, quitting and attempting to quit are hypothesized to occur and may have implications for cessation programs.

Methods. Telephone surveys were conducted in a large (n = 6,711) cohort of young men and women (average age 19.2 years) which was first established in 1979 and has been resurveyed several times since then. Questions concerned smoking, successful and unsuccessful attempts to quit, withdrawal symptoms during quit attempts, and concerns about quitting.

Results. More women than men reported current smoking (26.5 vs 22.6 percent), but quitting attempts, successful and unsuccessful, were equally common. Withdrawal symptoms were reported equally, except for wanting to eat more than usual and weight gain, both of which were reported more often by women than men. Women smokers reported substantially more concern about weight gain if they quit smoking (57.9 vs 26.3 percent expressing concern).

Conclusions. Targeted programs are needed to address issues of concern to young women smokers, particularly fear of gaining weight. (*Am J Public Health* 1991;81:324–327)

Introduction

The prevalence of smoking and the burden of smoking-related illness in this country are beginning to shift toward women. Among men, cross-sectional surveys on smoking status have presented a picture of steadily declining smoking rates from the 1960s to the present, coupled with a steady increase in the number of ex-smokers.[1-3] Among women, the percentage decline in smoking prevalence has been smaller.[3,4] Smoking prevalence rates in the youngest groups of adult women are beginning to exceed those in men, at least among whites,[1,5,6] and overall smoking rates among women are projected to exceed those among men by the latter part of the 1990s.[7]

Smoking in young women is particularly troubling because it not only poses hazards to their own long-term health,[8] but has immediate impacts on reproductive function[9,10] and the health of their children.[11,12] With a large population of young women continuing to take up smoking, there is a clear need to learn more about ways to help them quit smoking, as well as barriers to their quitting. This paper is an exploration of smoking, quitting, and attempted quitting behavior in a population of young adults, with particular attention to the experiences of young women.

Methods

The young adults in our study originally comprised the entire seventh-grade enrollment of four suburban districts in the Minneapolis-St. Paul, Minnesota, metropolitan area in two subsequent years, 1979 and 1980. They took part in two adolescent smoking studies, which have been described elsewhere.[13-15] Briefly, as seventh-graders, these students were exposed to variations of a "social influences" smoking prevention curriculum; long-term follow-up demonstrated modest differences in smoking prevalence among students in the various conditions through about eleventh grade,[14] but no differences after that time.[15]

The cohort of participating students was reconstructed in 1984-85 and resurveyed annually through 1988.[16,17] The data reported here are from the 1986-87 follow-up survey, at which time the participants were one or two years out of high school. The response rate for this survey was 94.6 percent, representing 6,711 of a total possible 7,096 interviews. An additional 28 members of the initial cohort were deceased or severely disabled and thus unavailable for interview.

Participants were randomly assigned to one of 11 months (excluding December) for annual follow-up and interviewed by telephone between October 1986 and November 1987. Data collected during the interview included items on current and former smoking status, quit attempts, withdrawal symptoms, perceived barriers to quitting, perceived pressures to quit, current weight and concern about weight. The smoking status variables reported here were based on self-report. In a separate analysis, a sample of individuals provided saliva samples for validation of smoking status;[18] results indicated that telephone self-report data are largely accurate in this population, although recent

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TABLE 1—Smoking and Quitting Behaviors in a Cohort of Young Men and Women with an Average Age of 19.2 Years

Behaviors	Men (95% CI) n = 3455	Women (95% CI) n = 3256
Of total		
% Ever smoked ≥ 100 cigarettes in lifetime	32.1 (30.5, 33.7)	37.6 (35.9, 39.3)
% Current smokers	22.6 (21.2, 24.0)	26.5 (25.0, 28.0)
% Ex-smokers	9.6 (8.6, 10.6)	11.2 (10.0, 12.2)
Of Current Smokers	(n = 779)	(n = 863)
Number of cigarettes smoked in the last 24 hours	16.2 (13.6, 18.8)	14.3 (12.0, 16.6)
% Tried to quit in past 12 months	62.6 (59.2, 66.0)	66.9 (63.8, 70.0)
% Would like to quit	76.1 (73.1, 79.1)	72.4 (69.4, 75.4)
% Changed brands in past 12 months to reduce tar and nicotine	32.4 (29.1, 35.7)	34.5 (31.3, 37.7)
Of those who have tried to quit in the last 12 months	(n = 487)	(n = 575)
Number of quit attempts lasting more than 1 week	1.6 (0.5, 2.7)	1.6 (0.6, 2.6)
Length of longest quit attempt (days)	28.5 (24.5, 32.5)	36.7 (32.8, 40.6)

TABLE 2—Self-Reported Smoking Habits Reflective of Addictive or Dependent Smoking Among Young Adult Current Smokers, by Gender

Smoking Habits	Men (95% CI) n = 779	Women (95% CI) n = 863
% Always inhale	93.6 (91.9, 95.3)	93.4 (91.7, 95.1)
% Smoke more in morning than in rest of day	13.4 (11.0, 15.8)	13.3 (11.0, 15.6)
% Smoke within 30 minutes of getting up	44.2 (40.7, 47.7)	35.6 (32.4, 38.8)
% First cigarette in morning is one would most hate to give up	32.3 (29.0, 35.6)	24.9 (22.0, 27.8)
% Find it hard not to smoke in places where it's forbidden	13.6 (11.2, 16.0)	11.6 (9.5, 13.7)
% Smoke even when ill	16.5 (13.9, 19.1)	12.6 (10.4, 14.8)

quitting may be overreported, a discrepancy unlikely to affect the gender-specific comparisons reported here.

Simple proportions and their 95 percent confidence intervals are reported for categorical variables, and means and their confidence intervals for continuous variables. All analyses were conducted using SAS.[19]

Results

The average age of the respondents in this survey was 19.2 years; 51 percent were male. Nearly all of the students were White; 37 percent were enrolled in four-year colleges and 23 percent in vocational schools or two-year colleges. All but 7 percent had graduated from high school.

As shown in Table 1, more women than men were current smokers, and more had ever smoked. The proportion who reported themselves as former smokers, however, was approximately the same in men and women. No gender differences were seen in amount of current smoking or on most of the questions designed to elicit quitting behaviors, although women self-reported slightly longer quit attempts.

The genders differed slightly on items reflecting addictive or dependent smoking[20] (Table 2) with more men reporting that they smoked within 30 minutes of getting up and that the first cigarette in the morning was the one they would most hate to give up.

Both current and former smokers were asked about withdrawal symptoms (Table 3), with unsuccessful quitters reporting higher withdrawal symptoms on all symptoms except weight gain. Women were more likely than men to report wanting to eat more than usual, and they also reported more weight gain. The suggestion that weight gain is differentially a problem for women (as compared to men) is not supported by the self-reported weights, however. Among women, the quitters weighed about the same as current smokers (127.2 lbs for each group, on average), while among men, the successful quitters were heavier than current smokers (167.3 vs 162.0 lbs).

Finally, we examined various beliefs about the social and physical aspects of quitting smoking which may act as barriers to quitting, as well as potential social pressures to quit (Table 4). Women were more likely to agree with two of the "barriers" items: "If I quit smoking, I would probably gain a lot of weight" and, "If I quit smoking, it would be hard to go out with friends who smoke." Women were also more likely to agree that they felt social pressure to quit, reporting that, "A doctor has strongly urged me to quit smoking" and, "The people I'm closest to would like me to quit smoking."

Discussion

Contrary to reports in the past that women smokers have had a much harder time quitting smoking than men,[20,21] these data indicate that both quitting attempts and successful quitting are equally common in both genders for young adults. This may be a positive indication that future smoking patterns will show similar trends for men and women, with higher quit rates among women than are seen in existing cross-sectional surveys of adult women. On the other hand, these data do indicate that more young women than young men are beginning to smoke and are continuing the habit into early adulthood, a time when the risks of smoking to their personal and reproductive health begin to be manifest.

It is interesting that the unsuccessful quitters reported higher levels of withdrawal symptoms on nearly all items, suggesting that elevated levels of withdrawal symptoms may have prevented their successful cessation, although the unsuccessful nature of the attempt may also have led them to overreport symptom severity in order to rationalize failure.

At least one study has found that women who attempt to quit smoking report more severe withdrawal symptoms than do men,[22] although others have failed to confirm this finding.[23,24] In the young adult cohort reported here, among both successful and unsuccessful quitters, women did not generally report more withdrawal symptoms than did men, in

TABLE 3—Percent of Young Adults Reporting Withdrawal Symptoms, by Gender:

Withdrawal Symptoms	Men (95% CI) n = 454	Women (95% CI) n = 538
*Current smokers—%**		
Irritability or impatience	54.8 (50.2, 59.4)	56.7 (52.5, 60.9)
Difficulty concentrating	28.2 (24.1, 32.3)	26.4 (22.7, 30.1)
Restlessness	57.7 (53.2, 62.2)	53.9 (49.7, 58.1)
Craving for a cigarette	82.8 (79.3, 86.3)	81.9 (78.6, 85.2)
Wanted to eat more than usual	31.9 (27.6, 36.2)	49.5 (45.3, 53.7)
Fatigue or lack of energy	19.0 (15.4, 22.6)	19.6 (16.2, 23.0)
Wanted to drink more fluids than usual	48.0 (43.4, 52.6)	41.5 (37.3, 45.7)
Weight gain	14.5 (11.3, 17.7)	26.1 (22.4, 29.8)
Former smokers—%†	(n = 229)	(n = 224)
Irritability or impatience	40.6 (34.2, 47.0)	33.0 (26.9, 39.2)
Difficulty concentrating	15.7 (11.0, 20.4)	8.9 (5.2, 12.7)
Restlessness	36.7 (30.4, 42.9)	29.9 (23.9, 35.9)
Craving for a cigarette	64.6 (58.4, 70.8)	62.5 (56.2, 68.8)
Wanted to eat more than usual	26.2 (20.5, 31.9)	47.8 (41.2, 54.3)
Fatigue or lack of energy	13.5 (9.1, 18.0)	15.2 (10.5, 19.9)
Wanted to drink more fluids than usual	35.4 (29.2, 41.6)	28.6 (22.6, 34.5)
Weight gain	19.2 (14.1, 24.3)	29.5 (23.5, 35.4)

**Current smokers who have attempted to quit within last 12 months; for most recent attempt lasting more than 24 hours.

†Former smokers, who quit within one year of interview.

TABLE 4—Percent Agreement with Statements Reflecting Barriers and Pressures to Quit Smoking Reported by Young Adult Current Smokers, by Gender

Barriers/Pressures	Men (95% CI) n = 779	Women (95% CI) n = 863
Barriers to Quitting—%		
If I quit smoking, I would probably gain a lot of weight	26.3 (23.2, 29.4)*	57.9 (54.6, 61.2)
If I quit smoking, I would feel tense and irritable	62.1 (58.7, 65.5)	67.7 (64.6, 70.8)
I enjoy smoking too much to quit	50.4 (46.9, 53.9)	50.9 (45.6, 54.2)
If I quit smoking, it would be hard to go out with friends who smoke	32.7 (29.4, 36.0)	46.5 (43.2, 49.8)
If I got tense and irritable from not smoking, it would make the people I'm closest to unhappy	54.7 (51.2, 58.2)	59.2 (55.9, 62.5)
Pressures to Quit—%		
A doctor has strongly urged me to quit smoking	20.2 (17.4, 23.0)	31.5 (28.4, 34.6)
The people I'm closest to would like me to quit smoking	63.5 (60.1, 66.9)	70.6 (67.6, 73.6)

*95% confidence interval.

fact, among the successful quitters, men tended to report more symptoms. Weight concerns, however, emerged in opposition to this general pattern, with both successful and unsuccessful quitters among women reporting eating more and gaining weight during quit attempts. Current women smokers strongly endorsed the notion that they would gain weight if they quit smoking. Interestingly, although women reported more concern about weight, the evidence did not suggest any large weight gains among the successful quitters in this group, who weighed, on average, exactly as much as their smoking counterparts. Although several published studies indicated that weight gain after quitting smoking was greater in women than men,[1] that finding was not supported in this population. It was clear, however, that concern about gaining weight is much more common in women than in men, and that such concern was excessive in light of the magnitude of the problem. While 57.9 percent of women smokers in our population agreed that they would probably gain a lot of weight if they quit smoking, only 26.2 percent of quit attempters and 29.5 percent of actual quitters reported gaining weight. Even those gains must have been modest or readily controlled, as average weights for quitters were not higher than for current smokers.

One limitation of this study is the nonrepresentative nature of the sample, which consists primarily of White young adults, the majority of whom are pursuing education beyond high school. This is reflected in the self-reported smoking rates, which are lower than those reported from national samples.[4]

The data reported here provide support for the observation that young women are smoking cigarettes in greater numbers than young men, and concern about weight gain emerges as a major issue for these young women smokers. Given the risks to their familes as well as to themselves, public health cessation efforts targeted to women continue to be warranted. Targeted programs need to address issues of concern to women, particularly fear of gaining weight. ☐

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The Food and Nutrition Section, American Public Health Association, is announcing the availability of the Helen R. Stacey and Joseph A. Walsh Awards for Graduate Education at the Master's Degree level in Public Health Nutrition. Three awards are given consisting of $2,000 each. These awards must be used for the academic year 1991–92. *Applications must be submitted no later than May 1, 1991.*

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Intake of Tapwater and Total Water by Pregnant and Lactating Women

Abby G. Ershow, ScD, Linda M. Brown, MPH, and Kenneth P. Cantor, PhD

ABSTRACT

Background. Despite theoretically higher requirements for water due to physiologic demands of pregnancy and lactation, little is known of actual ranges of intake in pregnant and lactating women.

Methods. Population-based estimates of total water and tapwater intake in women of reproductive age were derived using data from the 1977–78 USDA Nationwide Food Consumption Survey. Three-day average intakes were calculated for 188 pregnant women, 77 lactating women, and 6,201 non-pregnant, non-lactating control women.

Results. Total water intake (mean ± SD) was 1,940 ± 686 g/day (median 1,835) for control women, 2,076 ± 743 g/day (median 1,928) for pregnant women and 2,242 ± 658 g/day (median 2,164) for lactating women. Tapwater intake was 1,157 ± 635 g/day (median 1,065) for control women, 1,189 ± 699 g/day (median 1,063) for pregnant women, and 1,310 ± 591 g/day (median 1,330) for lactating women. Total water intake was equal to or greater than 3,000 g/day among 7 percent of control women, 11 percent of pregnant women, and 13 percent of lactating women. Tapwater intake was equal to or greater than 2,000 g/day among 10 percent of control women, 15 percent of pregnant women, and 8 percent of lactating women.

Conclusions. These results should be useful in estimating amounts of nutrients and toxic substances that women of reproductive age obtain through the water supply. (*Am J Public Health* 1991;81:328–334)

Introduction

Although weight gain during pregnancy and milk output during lactation cause a theoretical increase in the physiological requirement for water,[1] the actual range of water intake among pregnant and lactating women is not known.[2] The relative importance of water as a dietary source of nutrients such as calcium cannot be evaluated in the absence of intake data. Furthermore, secondary exposure of a fetus or nursing child to toxic substances in the water supply makes accurate data on quantities of water consumed by the mother particularly important in establishing criteria for setting allowances of contaminant levels. To make population-based estimates of quantities and sources of tapwater and total water ingested by pregnant and lactating women, we used data from a large national US Department of Agriculture (USDA) dietary survey,[3–5] which provided an opportunity to consider water intake from all sources including solid foods. For purposes of comparison, we have also estimated intakes for similarly aged non-pregnant, non-lactating women who participated in the same survey.

Methods

Survey Design

In 1977–78 the USDA conducted the Nationwide Food Consumption Survey (NFCS) to gather dietary information on individuals living in randomly sampled nonmilitary households in the contiguous 48 states.[3] The NFCS first sampled households and asked the head of household to complete a seven-day household food use and purchase record. Of the 20,812 households contacted, 14,930 (72 percent) agreed to participate in this activity. Ninety-four percent of the individuals sampled from the participating households completed an interview that included a 24-hour recall; they were then asked to keep a food diary for the next two days.[6]

Participating in the Individual Intake Survey were 30,770 persons.[3] Of these, 87 women stated that they were nursing a child aged two years or less, and 214 women stated that they were four or more months pregnant (women less than four months pregnant were classified by the USDA as not pregnant).[3,4] The pregnant and lactating women interviewed for the NFCS were 15–49 years of age; thus, for potential control subjects, we identified all female NFCS participants 15–49 years old who were neither pregnant nor lactating (n = 7,227).

Analytic Sample

Our data analysis was confined to those NFCS participants having complete and usable data on demographic variables of interest, self-reported weight and height, and all foods, beverages, and drinking water consumed for three consecutive days. Overall, 86 percent of interviewed participants,[7] including 188 pregnant women, 77 lactating women, and 6,201 non-pregnant, non-lactating control women, fit these criteria.

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To compensate for deletions, we developed a weighting factor ("NCI weighting factor") equal to the inverse of the retained (i.e., not deleted) proportion of participants in each age-sex-race-region-season stratum.[7] This NCI weighting factor was derived for the entire data set and applies to the pregnant and lactating participants as well; it did not reflect any assumptions regarding diet or water intake of non-respondents. The retained participants did not differ from the original sample with regard to the distribution of values for age, sex, race, region, season of interview, urbanization, and education of heads of household,[7] and for this reason we consider our analytic sample to be satisfactorily representative of all surveyed participants. All calculations incorporated the NCI weighting factor as well as a USDA weighting factor that reflected the interview completion rate in each sampling stratum.[3,4,7]

Definition of Terms

"Drinking water" refers to plain water consumed directly as a beverage, but does not include tapwater used to prepare foods and other beverages. "Tapwater" includes drinking water as well as tapwater added in final preparation of foods and tapwater-based beverages. "Total water" includes all water from tapwater and non-tapwater sources, including water contained in food.

Calculation of Tapwater and Total Water Intake

The methods, coding procedures, and specific assumptions used in calculating tapwater and total water intake from the 4,545 foods and beverages reported as consumed by NFCS study participants have been fully described elsewhere[7] and will be summarized here. For all food items listed on the surveyed individuals' dietary records,[5,8] an experienced nutritionist (author AGE) estimated the proportion of the total water content likely to derive from household tapwater added during preparation. Examples of this estimated tapwater proportion are: 100 percent (tea, coffee); 84 percent (reconstituted frozen fruit juices); 50 percent (most reconstituted canned soups); 0 percent (meats, fresh whole milk, fresh fruit, carbonated beverages). These tapwater proportion values were merged with data on the water content of foods[5,7] and on the quantities of foods (including soups) and beverages consumed,[4] providing an estimate of total water and tapwater intake from all foods and beverages. To these estimates we added the cups of drinking water consumed each day, yielding the quantities of total water and tapwater from each dietary source for each individual over three days.[7] The original USDA dietary data were recorded in common household units and converted to grams during data processing.[8] Our results are expressed in grams, in keeping with the format of the public use data tapes.[4]

Statistical Methods

All calculations and statistical procedures were conducted using the SAS software package,[9] and incorporated weighting factors (see above) reflecting the interview completion rate in each sample stratum and the deletion of participants with incomplete data.[7] Values represent three-day averages for each individual. All values reported in the text represent mean ± standard deviation. Values for the fraction of total water intake provided by tapwater (see Table 3, below) represent the mean proportion for individuals.[10] Values for the fraction of total water and tapwater intake provided by various dietary sources (see "Results," below) represent the population proportion.[10]

For the entire group of study subjects (n = 6,466), sources of between-individuals variation in daily total water and tapwater intake were examined using analysis of variance (ANOVA) for unbalanced designs (PROC GLM).[9] The model included main-effects terms for reproductive status, race, urban/rural residence, region, and season; and covariate terms for age, weight, height, and mean household educational level. Education of the heads of household was a surrogate measure for income, which many participants (21 percent) would not report. Comparisons of means were made using a multiple comparison test (LSMEANS PDIFF) based on the analysis-of-variance model, in which the significance of each contrast was determined after adjusting for all other main effects and covariates.[9]

Results

Characteristics of Participants

Demographic and physical characteristics of the study participants are shown in Table 1. The women were fairly evenly distributed among the northeastern, southern, midwestern and western regions of the country. Interviews took place during all four seasons of the year. Most of the women were white and lived in urban or suburban rather than rural areas. The lactating women were generally older than the pregnant women and tended to live in households with a higher level of education. Self-reported heights and weights of our study sample compared favorably with physical measurements of height and weight made on adult females participating in the second US National Health and Nutrition Examination Survey (NHANES II).[11]

Total Water Intake

Effect of Reproductive Status. Total water intake of study participants is shown in Table 2. Mean and median daily consumption of total water for all participants was approximately 2 liters (i.e., 2,000 g). The upper ranges of intake, however, were much higher. Seven percent of control women, 11 percent of pregnant women, and 13 percent of lactating women consumed 3 liters (3,000 g) or more total water per day. Three percent, 4 percent, and 3 percent of control, pregnant, and lactating women, respectively, had total daily water intakes equal to or exceeding 3.5 liters (3,500 g).

Reproductive status was significantly associated with total water intake ($p < .001$). Lactating women consumed the largest quantity (g/day) of total water ($p < .001$ compared with control mean), but the mean intake of pregnant women was also significantly elevated ($p < .05$ compared with control women). The total water intake of lactating women was considerably higher than that of pregnant women, but this difference was not statistically significant due to relatively small numbers of participants.

Lactating women also had the highest mean intake of total water when expressed in terms of body weight ($p < .01$ compared with both control and pregnant women). Total water intake per unit of body weight did not differ between pregnant and control women.

Of the 77 lactating women, 64 had infants who also were NFCS study subjects; no information was available regarding the other 13 infants. Total water intake of these 64 lactating mothers was not significantly correlated with either the age (mean = 5 mo) or weight (mean = 7 kg) of their infants.

Total water intake per unit of energy (i.e., g/kcal/day) did not vary as a function of reproductive status. This reflects the parallel increase of water and energy intake: control, pregnant, and lactating women consumed 1,592 ± 561, 1,719 ± 556, and 1,887 ± 626 kcal/day, respectively (mean ± SD).

TABLE 1—Characteristics of Study Participants

	Pregnant Women	Lactating Women	Non-pregnant Non-lactating Women (Controls)
Number of Observations	188	77	6201
Age (yr) (mean ± SD)	25.5 ± 5.6	27.1 ± 4.8	30.4 ± 10.0
Weight* (kg) (mean ± SD)	65.8 ± 10.6	61.9 ± 12.4	61.8 ± 13.0
Height* (cm) (mean ± SD)	164 ± 6	164 ± 6	163 ± 7
Race (%)†			
White	79.6	94.8	81.9
Black	14.5	4.2	13.7
Other	6.0	1.0	4.5
Education** (%)			
Less than high school	20.1	7.9	23.6
High school graduate	37.9	32.3	42.5
More than high school	41.4	59.8	33.4
Urbanization of residence (%)			
Rural	22.4	25.9	26.6
Urban/Suburban	77.6	74.1	73.4
Region of residence (%)			
Northeast	20.8	20.7	25.1
Midwest	29.4	35.6	25.7
South	26.4	13.7	30.3
West	23.3	30.0	18.8
Season interviewed (%)			
Spring	24.6	27.5	22.6
Summer	26.7	26.1	25.7
Autumn	23.1	18.8	26.6
Winter	25.6	27.6	25.1

*By self-report

†Percentages may not add to 100.0%.

**Refers to the female head of household, who usually was the study participant.

Effects of other factors. The effects of factors other than reproductive status on total water intake were also examined in the entire sample of 6,466 women. The most striking effects were due to regional variations in residence. Total water intakes were lowest in the northeast (mean ± SD 1,827 ± 819 g/day; n = 1,551), intermediate in the south (1,955 ± 844 g/day; n = 2,147) and midwest (1,972 ± 912 g/day; n = 1,666), and highest in the west (2,063 ± 1,096 g/day; n = 1,102). Regarding another aspect of residence, rural women consumed more total water than urban/suburban women (1,997 ± 866 g/day, n = 1,885 vs 1,931 ± 925 g/day, n = 4,581).

Effects of race on total water intake may have been due to variation in food and beverage preferences. The small number of non-White, non-Black women had higher total water intakes (2,017 ± 957 g/day, n = 241) than White women (1,953 ± 898 g/day, n = 5,379), who in turn had higher total water intakes than Black women (1,893 ± 960 g/day, n = 846). Seasonal variation in total water intake was due primarily to elevated intake during the summer (2,011 ± 1,006 g/day; n = 1,384). Intakes were very similar in the autumn (1,916 ± 930 g/day; n = 1,617), winter (1,938 ± 960 g/day; n = 1,523), and spring (1,926 ± 762 g/day; n = 1,942).

Tapwater Intake

Effect of reproductive status. Mean and median daily consumption of tapwater for all groups (Table 3) was approximately 1.1 liters (1,100 g). Two liters (2,000 g) or more of tapwater were consumed daily by 10 percent, 15 percent, and 8 percent of control, pregnant, and lactating women respectively. Four percent of control and pregnant women and 3 percent of lactating women ingested 2.5 liters (2,500 g) or more of tapwater daily. Similar to the situation for total water, lactating women had the highest mean daily tapwater consumption (p <.01 compared with control women). The difference in tapwater intake between lactating women and pregnant women was nearly as large, but not significant due to small numbers. Pregnant women consumed only slightly more tapwater than control women. When compared with control women, mean tapwater intake per unit of body weight (i.e., g/kg/day) was also significantly higher in lactating women (p <.05) but not in pregnant women. Pregnant women actually had a slightly lower intake of tapwater per kg body weight than control women, possibly reflecting weight gain in pregnancy or a shift to sources of fluid (such as milk) that contain relatively little tapwater.

Effects of other factors. Effects on tapwater intake of factors other than reproductive status were similar in direction to those for total water, but the magnitude of the effects was smaller. Region again was the strongest residential factor. Intake was highest in the south (1,228 ± 798) and west (1,208 ± 982) and intermediate in the midwest (1,166 ± 857), whereas women in the northeast consumed less tapwater (1,034 ± 743 g/day) than in all other regions. Rural women consumed more tapwater (1,237 ± 819 g/day) than urban/suburban women (1,132 ± 847 g/day). Tapwater intake of non-White, non-Black women (1,232 ± 815 g/day) was higher than that of either White women (1,159 ± 841) or Black women (1,143 ± 849 g/day). Seasonal intake, which varied only slightly, was highest in the summer (1,198 ± 918), followed by winter (1,165 ± 895), autumn (1,144 ± 861), and spring (1,130 ± 711).

Sources of Total Water and Tapwater

The contribution of various dietary sources to total water intake is shown in Table 4. The reader should note that the mass of the non-water fraction of the foods does not enter into the calculation. For example, pregnant women had a mean intake of total water from milk and milk drinks of 308 g/day (Table 4), but their mean intake of milk *per se* would be a slightly higher figure. The presence of zeros in the 50th percentile column indicates that at least half of the women in that particular group consumed essentially no legumes, nuts or seeds, fruit juice, tea, coffee, soft drinks, or alcoholic beverages over the three days of the study.

Considerable individual variation is demonstrated by the marked differences in intake between the mean, median, and 95th percentiles. For example, the average coffee and tea intake of our subjects was not especially high. Table 4 shows that mean intake for pregnant women was 132 g water/day in tea and 197 g water/day in coffee, whereas lactating women consumed, on average, 253 g water/day in tea and 205 g water/day in coffee (an 8-oz cup = 240 g water). The even lower 50th percentile values indicate that many of the women did not consume any tea or coffee at all. Nevertheless, a small fraction of subjects, representing the top 5 percent of

TABLE 2—Total Water Intake of Women 15–49 Years Old

Reproductive Status*	Mean	Standard Deviation	Percentile Distribution						
			5	10	25	50	75	90	95
g/day									
Control	1940	686	995	1172	1467	1835	2305	2831	3186
Pregnant	2076	743	1085	1236	1553	1928	2444	3028	3475
Lactating	2242	658	1185	1434	1833	2164	2658	3169	3353
g/kg/day									
Control	32.3	12.3	15.8	18.5	23.8	30.5	38.7	48.4	55.4
Pregnant	32.1	11.8	16.4	17.8	22.8	30.5	40.4	48.9	53.5
Lactating	37.0	11.6	19.6	21.8	28.4	35.1	45.0	53.7	59.2
g/kcal/day									
Control	1.3	0.9	0.7	0.8	0.9	1.2	1.5	2.0	2.5
Pregnant	1.3	0.5	0.7	0.8	0.9	1.2	1.5	1.9	2.2
Lactating	1.3	0.4	0.7	0.8	1.0	1.2	1.5	1.8	2.1

*Number of observations: non-pregnant, non-lactating controls (n = 6,201); pregnant (n = 188); lactating (n = 77).

TABLE 3—Tapwater Intake of Women 15–49 Years Old

Reproductive Status*	Mean	Standard Deviation	Percentile Distribution						
			5	10	25	50	75	90	95
g/day									
Control	1157	635	310	453	709	1065	1503	1983	2310
Pregnant	1189	699	274	419	713	1063	1501	2191	2424
Lactating	1310	591	430	612	855	1330	1693	1945	2191
g/kg/day									
Control	19.1	10.8	5.2	7.5	11.7	17.3	24.4	33.1	39.1
Pregnant	18.3	10.4	4.9	5.9	10.7	16.4	23.8	34.5	39.6
Lactating	21.4	9.8	7.4	9.8	14.8	20.5	26.8	35.1	37.4
Fraction of daily total water intake (%)									
Control	57.2	18.0	24.6	32.2	45.9	59.0	70.7	79.0	83.2
Pregnant	54.1	18.2	21.2	27.9	42.9	54.8	67.6	76.6	83.2
Lactating	57.0	15.8	27.4	38.0	49.5	58.1	65.9	76.4	80.5

*Number of observations: non-pregnant, non-lactating controls (n = 6,201); pregnant (n = 188); lactating (n = 77).

intake (i.e., the 95th percentile), drank nearly one liter per day of caffeinated beverage.

Sources of tapwater are shown in Table 5. Nearly all the tapwater consumed was provided by a small number of dietary items: drinking water; coffee; tea; grain and grain products; and fruit juices. (Carbonated beverages, most alcoholic beverages, and many fresh foods do not contain tapwater in the first place.) In contrast, a larger range of foods and beverages served as substantial sources of total water (Table 4).

Reproductive status had little effect on the relative contribution (expressed as the population proportion[10]) of drinking water, beverages, and foods to intake of total water (Table 4). For control, pregnant, and lactating women, respectively, the contribution to total water intake was 30 percent, 34 percent, and 30 percent for drinking water; 46 percent, 43 percent, and 45 percent for other beverages; and 24 percent, 23 percent, and 25 percent for foods.

Sources of tapwater intake varied more with reproductive status (Table 5). Drinking water contributed a larger fraction of the tapwater intake of pregnant women (58 percent) than for either control women (50 percent) or lactating women (52 percent). Other beverages accounted for a population proportion of 34 percent, 43 percent, and 41 percent of the tapwater intake of pregnant, control, and lactating women, respectively. Only 7 percent of the tapwater intake of our study participants was contributed by solid foods.

Discussion

By providing population-based estimates of total water and tapwater intake by pregnant and lactating women, our study addresses a nearly complete lack of information on this topic. Recent national surveys of tapwater use in Great Britain[12] and Canada[13] did not present data for pregnant or lactating women. Studies conducted by the California State Department of Health on the relationship of pregnancy outcome and water exposure did not evaluate quantities of water consumed from all sources.[14] A clinical study of fluid intake during lactation was very thorough but was conducted in a single locale (Iowa) using 26 self-selected volunteers.[1,15]

Our estimates derive from a relatively large final analytic sample that included 188 pregnant women and 77 lactating women. NHANES II,[16] which also used a stratified random national sampling design, included even fewer pregnant (n = 122) and lactating (n = 41) women than the 1977–78 NFCS. Larger numbers of pregnant and lactating participants would be desirable but cannot

TABLE 4—Total Water (g/Day) Derived from Various Dietary Sources by Women Aged 15–49 Years[*]

	Control Women			Pregnant Women			Lactating Women		
		Percentile			Percentile			Percentile	
Sources	Mean[†]	50	95	Mean[†]	50	95	Mean[†]	50	95
Drinking water	583	480	1440	695	640	1760	677	560	1600
Milk and milk drinks	162	107	523	308	273	749	306	285	820
Other dairy products	23	8	93	24	9	93	36	27	113
Meats, poultry, fish, eggs	126	114	263	121	104	252	133	117	256
Legumes, nuts, and seeds	13	0	77	18	0	88	15	0	72
Grains and grain products	90	65	257	98	69	246	119	82	387
Citrus and non-citrus fruit juices	57	0	234	69	0	280	64	0	219
Fruits, potatoes, vegetables, tomatoes	198	171	459	212	185	486	245	197	582
Fats, oils, dressings, sugars, sweets	9	3	41	9	3	40	10	6	50
Tea	148	0	630	132	0	617	253	77	848
Coffee and coffee substitutes	291	159	1045	197	0	955	205	80	955
Carbonated soft drinks[**]	174	110	590	130	73	464	117	57	440
Non-carbonated soft drinks[**]	38	0	222	46	0	257	38	0	222
Beer	17	0	110	7	0	0	17	0	147
Wine, spirits, liqueurs, mixed drinks	10	0	66	5	0	25	6	0	59
All Sources	1940	NA	NA	2076	NA	NA	2242	NA	NA

[*] Number of observations: nonpregnant, non-lactating controls (n = 6,201); pregnant (n = 188); lactating (n = 77).

[†] Individual means may not add to all-sources total due to rounding.

[**] Includes regular, low-calorie, and no-calorie soft drinks.

NA: Not appropriate to sum the columns for the 50th or 95th percenties of intake.

TABLE 5—Tapwater (g/Day) Derived from Various Dietary Sources by Women Aged 15–49 Years[*]

	Control Women			Pregnant Women			Lactating Women		
		Percentile			Percentile			Percentile	
Sources	Mean[†]	50	95	Mean[†]	50	95	Mean[†]	50	95
Drinking water	583	480	1440	695	640	1760	677	560	1600
Milk and milk drinks	5	0	0	16	0	73	15	0	130
Other dairy products[**]	—	—	—	—	—	—	—	—	—
Meats, poultry, fish, eggs	15	0	70	12	0	65	15	0	70
Legumes, nuts, and seeds	8	0	45	11	0	54	8	0	54
Grains and grain products	42	20	164	46	21	170	61	35	240
Citrus and non-citrus fruit juices	26	0	138	34	0	161	39	0	153
Fruits, potatoes, vegetables, tomatoes	9	0	65	9	0	56	11	0	57
Fats, oils, dressings, sugars, sweets	4	0	33	4	0	24	3	0	37
Tea	148	0	630	132	0	617	253	77	848
Coffee and coffee substitutes	291	159	1045	197	0	955	205	80	955
Carbonated soft drinks[**][††]	—	—	—	—	—	—	—	—	—
Non-carbonated soft drinks[††]	27	0	188	31	0	203	21	0	148
Beer[**]	—	—	—	—	—	—	—	—	—
Wine, spirits, liqueurs, mixed drinks	1	0	0	0	0	0	0	0	0
All Sources	1157	NA	NA	1189	NA	NA	1310	NA	NA

[*] Number of observations: non-pregnant, non-lactating controls (n = 6,201); pregnant (n = 188); lactating (n = 77).

[†] Individual means may not add to all-sources total due to rounding.

[**] Foods and beverages in this category are not sources of tap water.

[††] Includes regular, low-calorie, and no-calorie soft drinks.

NA: Not appropriate to sum the columns for the 50th or 95th percentiles of intake.

readily be obtained without expensive oversampling procedures.

We think it unlikely that our estimates of water intake are affected by serious non-response bias. The overall household response rate for the 1977–78 NFCS was 72 percent, very similar to the 73 percent individual response rate obtained for NHANES II,[11] and nearly all eligible individuals (94 percent) within participating NFCS households agreed to participate in the individual intake surveys as well. Furthermore, dietary data are probably no more susceptible to bias than other types of health information, and NHANES II investigators found no indication of household non-response bias for health-related variables.[11] In addition, there is no evidence that water intakes of persons with complete data differed systematically from intakes of persons lacking complete data. We thus consider our analytic sample to be representative of the surveyed study groups.

How reproducible (i.e., reliable) and accurate (i.e, valid) are our estimates? Few other data are available, but our estimates compared favorably with them. Median intake of at-home drinking water (plain tapwater) by pregnant women interviewed by the California Department of Health was 2–3 cups per day,[14] very similar to our finding that median drinking water intake of pregnant women was 640 g (2.7 cups) per day (Tables 4 and 5). The lactating women in our study had an average total water intake per unit of energy (1.3 g/kcal/day; Table 2) similar to that reported by lactating women in the Iowa study (1.4 g/kcal/day)[2] and in both studies two-thirds of the participants consumed more than the recommended 1 g/kcal.[1] As expected, our larger national sample of lactating women had a wider range of total water intake values (1,087–4,159 g/day), which completely encompassed the range for the 26 Iowa participants (1,920–3,957 g/day).[2] Both our study and the Iowa study found the highest level of total water intake to be approximately 4 liters (4,000 g) per day.

The non-pregnant, non-lactating control women in our study had a mean intake of total water from beverages (1,480 g/day; Table 4) very similar to that of adult British women (1.5–1.6 L/day).[12] Intake of tapwater from beverages (1,081 g/day; Table 5) also was very similar to that of British women (1.0–1.1 L/day).[12] Canadian women, on the other hand, consumed relatively more tapwater-based beverages (1.3–1.6 L/day).[13]

As the comparisons above indicate, our results are generally compatible with other published data despite differences in study population, intake methodology, and sample size. It is possible, however, that our estimates are on the low side. Using three days' worth of data for each participant would presumably allow the under-reporting biases of 24-hour recalls and the over-reporting biases of dietary records to balance out.[6,17] Nevertheless, energy intakes reported by NFCS participants were lower than expected and were very similar to the energy intakes yielded by the single 24-hour recall used in the NHANES II survey.[18] Under-reporting of food intake thus may account for the lower mean total water intake of our lactating study subjects (2,242 g/day, Table 2) compared with that of the Iowa participants (2,860 g/day).[2] Alternatively, the diets of the highly educated Iowa participants may not have been representative of lactating women's diets in general. The Iowa participants were studied as part of an attempt to increase milk production by deliberately increasing fluid intake,[15] and they may have been consuming extra fluid even during the baseline phase of the study.

How timely are the estimates? The data used for this analysis were collected in 1977–78. In the last decade there have been important changes in certain aspects of the food supply, including increased purchase and consumption of meals outside the home and greater intake of carbonated soft drinks.[19] Unfortunately, the USDA's more recent Continuing Survey of Food Intake by Individuals[19] did not collect information on intake of plain water (i.e., drinking water), and data from these surveys therefore cannot be used to derive either tapwater or total water intake.

Our population-based cross-sectional study confirms that pregnancy and lactation are associated with significant increases in water intake, although a prospective study design is needed to evaluate whether water intake increases spontaneously with the onset of pregnancy and lactation. The estimated theoretical increase in water requirement caused by lactation is 0.5–1.0 L/day[1,20] but in our study the mean daily total water intake of lactating women was only 302 g (i.e., 302 ml) higher than the total water intake of control women (Table 2). The non-pregnant, non-lactating control women in our study consumed quantities of total water well above the minimum amount needed to prevent dehydration. This implies that many if not most women may not need to increase their water intake when they become pregnant or begin to lactate, because their pre-pregnancy intakes were already more than adequate. Unnecessary recommendations to consume "lots of fluids" might inspire some women to replace nutritionally valuable solid foods with water or other nutrient-free beverages such as tea, coffee, or diet soda. Dietary counseling might be better directed towards the few women who habitually consume very small amounts of liquid.

Our evaluation of the relative contribution of various dietary sources to total water and tapwater intake has implications for questionnaire design. Studies of water consumption can be conducted more efficiently by limiting questions to the most important sources. We found that drinking water, coffee, and tea alone accounted for a population proportion[10] of 87 percent of tapwater intake by our study participants (calculated as the sum of source-specific means divided by the all-sources mean, Table 5). Adding reconstituted fruit juices and cooked grain products (such as rice, hot cereal, noodles, pasta) to this list brings this figure to 94 percent. A nearly complete assessment of the quantities of tapwater consumed could thus be made using a relatively short questionnaire. A longer list of sources (Table 4) would be needed to assess total water intake by questionnaire.

We found that women living in rural areas and in the western or southern regions of the United States consumed more total water and tapwater than women living in urban/suburban areas in the northeast and midwest. This could reflect differences in climatic temperature and humidity, physical activity, and diet, particularly beverages. Estimates of intake of water-borne elements might be improved by taking these residential factors into account. Season, on the other hand, was responsible for less variation, probably due to climate control and alternation throughout the year of hot and cold drinks. Similar minor effects of season were observed in Canada, where tapwater intake was slightly (5–10 percent) higher in the winter.[13] The Iowa study[2,15] also found that total water intake by lactating women was minimally affected by season.

Our findings may be used to estimate intake of minerals via tapwater. Calcium is of particular interest because of the very high demands imposed by reproduction; the Recommended Dietary Allowance (RDA) for calcium for most adult women is 800 mg/day, whereas for pregnant and lactating women the RDA is 1,200 mg/day.[1] The calcium content of home water supplies averages 50–60 mg/L, although in hard water areas the concentration may reach 145 mg/liter.[21] In the typical situation, pregnant or lactating women ingesting 1.2–1.3 liters/day of tapwater (Table 3) from the home supply would take in by this route only 60–80 mg/day of calcium, or about 5 percent of the 1,200 mg recommended daily allowance. Only the women living in areas with very hard water (145 mg/L) and drinking unusually large quantities of this hard water (2.2–2.4 L/day; 95th percentile of intake; Table 3) would obtain an appreciable amount of calcium from the tap.

Estimates of exposure to toxic metals and chemicals in tapwater often are made with the assumption that few persons consume more than 2 liters per day[21–24]. Canadian researchers found that 12 percent of adults consumed 2 liters or more of tapwater daily.[13] In our study 10 percent of the non-pregnant, non-lactating women, 8 percent of the lactating women, and 15 percent of the pregnant women consumed 2,000 g/day or more of tap water (see "Results"), and 3–4 percent consumed 2,500 g or more. This suggests that 2 liters/day might not be a sufficiently high estimate of intake to protect 95 percent of these susceptible population groups, particularly pregnant women, from water-borne toxic substances unless a sufficient margin of safety is incorporated into estimates of exposure. ☐

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Regression-Adjusted Small Area Estimates of Functional Dependency in the Noninstitutionalized American Population Age 65 and Over

ABSTRACT

Health planning efforts for the population age 65 and over have been hampered continually by the lack of reliable estimates of the noninstitutionalized long-term care population. Until recently national estimates were virtually nonexistent, and reliable small area estimates remain unavailable. However, with the recent publication of several national surveys and the 1990 Census, synthetic estimates can be made for states and counties by using multivariate methods to model functional dependency at the national level, and then applying the predicted probabilities to corresponding state and county data.

Using the 1984 National Health Interview Survey's Supplement on Aging and the 1986 Area Health Resources File System, we have produced log-linear regression models that include demographic and contextual variables as predictors of functional dependency among the noninstitutionalized population age 65 and over. Age, sex, race, and the percent of the 65 and over population who reside in poverty were found to be significant predictors of functional dependency. Applying these models to 1986 Medicare Enrollment Statistics, regression-adjusted synthetic estimates of two levels of functional dependency were produced for all states and—as examples of how the rates can be used to produce additional synthetic estimates—the largest county in each state. We also produced point estimates and standard errors for the national prevalence of functional dependency among the noninstitutionalized population age 65 and over. (*Am J Public Health* 1990;81:335–343)

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Introduction

Bivariate correlates of functional dependency suggested in previous work include age,[1–11] being female,[3,4,6–10,12] being of a race other than White,[3,10] being unmarried or residing with family members,[6,7,10] living alone,[13] having a low income,[7,10,11] and being at the low end of the social class continuum.[7] However, Feller[1] found no significant difference in rates of dependency by gender; Dawson, Hendershot, and Fulton[5] found gender differences to disappear when age structure was taken into account; and Jette and Branch[13] found that among those who lived with others, level of income was inversely related to increasing disability.

A few researchers have also investigated the relationship of functional dependency to other factors with the use of multivariate methods. Among these age,[10,14,15–17] physical performance,[10,14] number of chronic conditions,[14,15] sex,[14] race,[14] emotional performance,[14] health status,[14] prior functional abilities,[10] social class,[15] income,[15] and education[16] have been shown to be significantly related to level of functional dependency.

Yet, health planning efforts for the population age 65 and over continue to be hampered by the lack of reliable data and methods for making population-based estimates at subnational levels. Unger and Weissert's[17] research, which used 1977 data to produce synthetic estimates of the functionally dependent noninstitutionalized age 65 and over population, was forced to rely upon a data set with much more limited measures of dependency than those available on more recent national surveys.

Although several methods exist to produce synthetic estimates, none has been found to be uniformly superior. One well suited method uses a fitted regression model to predict outcomes from correlates of the trait or characteristic of interest. This approach has been widely used.[17–29]

This paper presents log-linear regression models as well as regression-adjusted synthetic estimates of the noninstitutionalized dependent age 65 and over population in each state and its largest county. With appropriate caution the rates generated by the models can be applied to the number of noninstitutionalized age 65 and over individuals in various age, sex, race, and poverty subgroups living in other counties to produce synthetic estimates of the prevalence of dependency for those counties.

Methods

Data Sources and Definitions

Data were drawn from the 1984 National Health Interview Survey's Supplement on Aging, the 1986 Area Resource File System, *State, Regional, and Na-*

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tional Monthly and Seasonal Heating Degree Days,[30] and 1986 Medicare Enrollment Statistics.

The 1984 Supplement on Aging, based on a multistage area probability sample, provides self-reported characteristics (such as conditions and impairments, living arrangement, and functional abilities) for 11,497 civilian noninstitutionalized people age 65 and over. A more detailed description of the survey is provided by Fitti and Kovar.[31]

Contextual variables were drawn from two sources: the 1986 Area Resources File System and *State, Regional, and National Monthly and Seasonal Heating Degree Days*. The 1986 Area Resource File System is a county-specific data base containing more than 7,000 variables concerning a wide range of social, economic, and health resource characteristics, and is described in detail elsewhere.[32] The use of one additional contextual variable, heating degree days (which is available from the National Oceanic and Atmospheric Administration) was examined.

Using the geographic identifiers available on the 1984 Supplement on Aging, corresponding contextual variables from the above two sources were attached at the Standard Metropolitan Statistical Area (SMSA) for individuals residing in one of 31 large self-representing SMSAs. Individuals on the data set who resided outside these 31 areas were assigned the corresponding regional (northeast, north central, south, or west) and urbanity (SMSA or nonSMSA) average for their type of residence. The result was 39 distinct geographic areas: 31 self-representing SMSAs, and four urban and four nonurban regional areas.

Synthetic estimates are produced by multiplying the regression-adjusted national rates by population data. Because any explanatory variable included in the national model must also be available in the small area population data, Medicare Enrollment Statistics were used for small area population data. Enrollment data by age, sex, and race for each state and county in the United States are available from the Bureau of Data Management and Strategy at the Health Care Financing Administration.[33]

Model Specification

Unit of Analysis

The unit of analysis for this study was the individual participant in the 1984 Supplement on Aging. Although the weighted sample size of the 1984 Supplement on Aging is over 26 million, we normalized the provided survey weight variable to sum to the actual sample size of 11,497 so as not to exaggerate significance levels in model evaluation.

Dependent Variable

The dependent variable for our analysis was a three level hierarchical measure which classified individuals into their highest level of dependency defined as follows.

ADL Dependent: Individuals residing in the community who, because of a health or physical problem, reported that at the time of the survey they had difficulty with and received human assistance with eating, transferring, toileting, dressing, or bathing.

Mobility/IADL Dependent: Individuals residing in the community who, at the time of the survey, were not ADL dependent, but because of a health or physical problem reported difficulty with and received human assistance with inside mobility, outside mobility, meal preparation, grocery shopping, money management, housework (light and heavy), or telephone usage.

Independent: Individuals residing in the community who, at the time of the survey, were neither ADL nor IADL dependent.

Explanatory Variables

Coupling the constraints of the Supplement on Aging and Medicare county data, the following explanatory variables were available for use:

- Sex (coded 1 if female and 0 if male);
- Race (coded 1 if other and 0 if White);
- Age Group (coded as a zero-centered variable equal to the midpoint age in five-year intervals from 65 to 85 and over minus 77.5, divided by 5, i.e. −2, −1, 0, 1, or 2);
- Age-Squared (coded as the square of the "age group" variable, i.e. 4, 1, 0, 1 or 4); and
- Pairwise Interactions (coded as the product of the pair).

In addition, a number of contextual variables were hypothesized to affect the rate of functional dependency among the noninstitutionalized population age 65 and over. These included:

- the number of nursing home beds per 1,000 population age 65 and over;
- the number of unoccupied nursing home beds per 1,000 people age 65 and over;
- the number of acute care hospital beds per 1,000 people age 65 and over;
- the per capita income of the population;
- the percent of the persons age 65 and over who reside in poverty;
- the number of primary care physicians per 1,000 persons age 65 and over;
- the percent of the poverty population that is covered by Medicaid;
- the age-adjusted mortality rate;
- the population per square mile;
- the population age 65 and over per square mile;
- the percent of the population that resides in an urban area; and
- heating degree days (the annual number of degrees of heating or cooling which would be required to move an area's temperature one degree for one day toward 68 degrees Fahrenheit).

Each of the contextual variables was evaluated for entry into the models both continuously and categorically. For the categorical analysis the variables were collapsed into three levels: high, medium, and low—coded −1, 0, and 1, respectively.

Statistical Methods

Given the multinomial nature of the dependent variable, a multicategory extension of logistic regression which provides a general structure was used. (The structure imposed on the data by an ordered logistic regression model was evaluated and found to be inappropriate.) The log-linear model was fit using a SAS supported procedure designed for categorical data modeling, PROC CATMOD.[34] For log-linear model analysis, CATMOD uses maximum likelihood estimation. Given the three category dependent variable, two sets of parameter estimates were produced: one for the logged ratio of not dependent to ADL dependent, and one for the logged ratio of IADL dependent to ADL dependent. Working with these two equations simultaneously yielded a formula for each category of the dependent variable: 1) not dependent; 2) IADL dependent; and 3) ADL dependent.

Because failure to account for the complex sampling design of surveys such as the Supplement on Aging can lead to underestimated variances of the regression coefficients, the magnitude of the design effects was tested with RTILOGIT.[35] Results confirmed previous findings that design effects on the Supplement on Aging

TABLE 1—Regression Results: Predictors of Functional Dependency among the American Noninstitutionalized Age 65 and Over Population[a]

Variables	Log (Prob. not dependent/ Prob. ADL dependent)		Log (Prob. IADL dependent/ Prob. ADL dependent)		
	Coefficient	Standard Error	Coefficient	Standard Error	Chi-Square[b] (d.f. = 2)
Race	−.41	.12	−.02	.13	28.56
Sex	−.17	.08	.71	.09	217.76
Age group	−.59	.03	−.20	.03	654.65
Age group-squared	−.11	.02	−.07	.02	29.23
Poverty	−.35	.07	−.15	.06	36.66
Intercept	2.51	.08	.44	.09	1920.81

[a] Lack of fit chi-square = 128.13, d.f. = 108, p = .0906. Model chi-square = 959.14, d.f. = 10, p = .001.
[b] p < .001

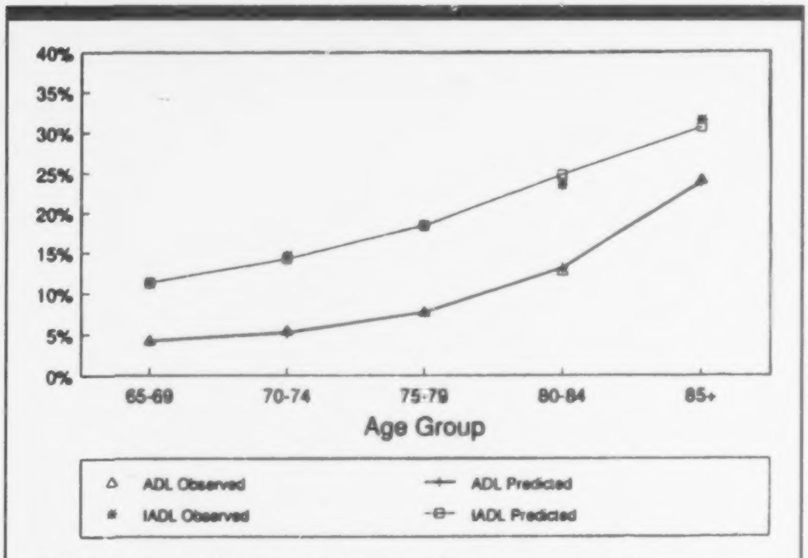

FIGURE 1—Observed and Predicted ADL and IADL Dependency Rates

are relatively small,[31] and estimates produced by complex sample methods such as RTILOGIT would not alter results or conclusions.

For model testing, the data base was randomly divided in half within each primary sampling unit. In the first half of the data base candidate models were fit for the dependent variable. Once model development was completed, the goodness-of-fit of the model was validated in the other half of the data base as described in the Appendix.

Results

Direct Estimates

Direct estimates from the 1984 Supplement on Aging show that in 1984 approximately 2.0 million (7.3 percent) of the noninstitutionalized population age 65 and over in the United States suffered from at least one ADL dependency, and an additional 4.2 million (16.4 percent) suffered from at least one IADL dependency. National prevalence and percentage estimates by race, sex, and age and their accompanying standard errors are presented in Appendix Tables A1-A4.

Regression-Adjusted Results

Table 1 presents the survey-weighted results of the log-linear regression analysis. Five variables were selected to form the final model: race, sex, age, age-squared, and one contextual variable, the categorical variable reflecting the percent of the population age 65 and over who reside in poverty. Each was a significant predictor of functional dependency in the overall model.

Other contextual variables were eliminated from the model. Three of these variables (when entered as the sole contextual variable in the model) had p-values < .02 (the number of heating degree days, the ratio of Medicaid recipients to the population below poverty, and the number of unoccupied nursing home beds per 1,000 elderly). However, all p-values became nonsignificant (p > .05) when entered in the model in combination with the poverty variable.

While theoretical considerations would argue for inclusion of these and the other contextual variables in the model, inclusion complicates the calculation of synthetic estimates. Since the goal of our study was to provide a practical and easily administered tool for producing synthetic estimates we elected to omit nonsignificant variables from our model.

Similarly, although the continuous form of the poverty variable might seem preferable from a statistical perspective, differences in conclusions between the continuous and the categorical form of the variable were negligible, and as results and examples could more easily be presented with the categorical variable, results presented are for the latter.

The fit of this model was evaluated with the log-likelihood ratio chi-square statistic. Since the statistic was nonsignificant, the use of the model was supported. The need for pairwise interactions of the variables was evaluated and determined to be unnecessary.

Further evaluation of the fit of the model was done as described in the Appendix, and by plotting the observed age-specific rates of dependency and the regression-predicted rates of dependency. Both ADL and IADL predicted rates closely approximate the observed rates (Figure 1). However, when the population

TABLE 2—Percentages of ADL Dependent Americans Age 65 and Over Living in the Community by Age, Sex, and Race: Regression-adjusted Estimates

Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
Low (<8%) Poverty Community							
White	Male	2.5	3.2	4.9	9.1	18.8	4.3
	Female	2.8	3.4	5.1	9.0	17.4	5.6
	Both	2.7	3.4	5.1	9.0	17.7	5.1
All Others	Male	3.7	4.6	7.0	12.4	24.1	6.5
	Female	3.9	4.8	7.0	11.7	21.1	6.1
	Both	3.8	4.8	7.0	11.8	23.0	6.2
All races	Male	2.7	3.3	5.1	9.3	19.9	4.5
	Female	2.9	3.6	5.3	9.3	17.5	5.6
	Both	2.8	3.5	5.2	9.3	18.1	5.2
Moderate (8–15%) Poverty Community							
White	Male	3.5	4.4	6.7	12.1	23.9	6.4
	Female	3.8	4.7	6.9	11.7	21.5	7.2
All Others	Male	5.1	6.3	9.4	16.2	29.7	7.9
	Female	5.3	6.4	9.1	14.8	25.5	9.0
	Both	5.2	6.4	9.3	15.3	26.4	8.5
All Races	Male	3.7	4.6	6.9	12.4	24.0	6.5
	Female	3.9	4.8	7.0	11.9	21.7	7.3
	Both	3.8	4.7	6.9	12.0	22.4	7.0
High (>15%) Poverty Community							
White	Male	4.9	6.1	9.1	15.9	29.7	8.4
	Female	5.2	6.3	9.1	14.9	26.2	9.0
	Both	5.1	6.2	9.1	15.3	27.3	8.8
All Others	Male	7.0	8.5	12.5	20.7	35.9	11.4
	Female	7.1	8.4	11.8	18.4	30.2	11.3
	Both	7.1	8.5	12.0	19.0	32.3	11.3
All Races	Male	5.2	6.4	9.7	16.4	30.6	8.9
	Female	5.5	6.7	9.5	15.5	26.7	9.4
	Both	5.3	6.6	9.6	15.8	28.0	9.2

is divided into smaller subgroups, such as females of a race other than White, the model fits somewhat less well, but this could be due to the greater variability in those cases from reduced sample size.

Table 2 presents regression-adjusted estimates of the prevalence of ADL dependency, and Table 3 of IADL dependency. Because the poverty variable has three values—less than 8 percent (low); between 8 and 15 percent (moderate); and over 15 percent (high) of the population age 65 and over residing in poverty—three sets of estimates were produced.

Results showed the relative likelihood of both ADL and IADL dependency increases quadratically with age, is higher if of a race other than White, and increases with an increasing percent of the population age 65 and over residing in poverty. The likelihood of IADL dependence is higher if female, but the relative likelihood of being ADL dependent if female varies across age, race, and poverty groups. Although it is in general higher for females than males until age 80 in communities of low and moderate levels of poverty, and until age 75 for those in high poverty communities, after these ages the percent of noninstitutionalized males with an ADL impairment is either equal to or greater than that of females.

Regression-Adjusted Synthetic Estimates

Although Medicare Enrollment Statistics were the best available population data, two adjustments had to be made. First, because approximately 5 percent of the population age 65 and over is not enrolled in Medicare, the numbers were inflated to reflect the total population age 65 and over. The percent of the population age 65 and over enrolled in Medicare varies little across sex or family income groups, but does differ across race groups,[36] therefore the number of White Medicare enrollees was inflated by 4.4 percent, and the number of all other enrollees was inflated by 13.5 percent.

Second, because Medicare Enrollment data include both the noninstitutionalized and institutionalized age 65 and over population, and rates produced from our analysis are applicable for the noninstitutionalized population only, the numbers therefore were deflated to remove the noninstitutionalized age 65 and over population.

Using the 1985 National Nursing Home Survey and the 1985 National Health Interview Survey, a logistic regression equation was produced to estimate rates of institutionalization among the age 65 and over population at the national level. Candidate explanatory variables for inclusion in the model included those available on the merged data set for which corresponding population data existed. Given this constraint, age (in five-year intervals from 65 to 85 and over), sex, race (White and all others), and geographic region (northeast, north central, south, and west), as well as their pairwise interactions and transformations were available for use. Region was included because the supply of nursing home beds varies geographically.[37] The model found to best fit the data included age, age-squared, sex, and an indicator variable reflecting whether or not the individual resided in the north central region of the country. Estimates produced from the model were used to deflate the state and county population data to be representative of the noninstitutionalized age 65 and over population (results are available from the authors).

By applying the regression-adjusted rates of dependency to the adjusted Medicare data, synthetic estimates of the functionally dependent noninstitutionalized age 65 and over population were produced for each state, and the largest county in each state (Tables 4 and 5).

These estimates are based upon three assumptions. First, that the race, sex, age, and poverty-specific disability rates from the 1984 Supplement on Aging did not change between 1984 and 1986. Second, that the relationship between dependency and race, sex, age, and the percent of the population age 65 and over residing in poverty is the same for each state and its largest county as it is for the nation. And third, that race, sex, age, and the percent of the population age 65 and over residing in poverty are the only important predictors of functional dependency. Thus, the estimates will err to the extent that the relationship between dependency and race, sex, age, and poverty in a community has changed over time; the extent that the relationships vary from national averages; and the extent to which other known or unknown factors

TABLE 3—Percentages of IADL Dependent Americans Age 65 and Over Living in the Community by Age, Sex, and Race: Regression-adjusted Estimates

Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
Low (<8%) Poverty Community							
White	Male	5.2	6.6	8.9	12.5	17.3	7.3
	Female	11.7	14.4	18.8	25.2	32.5	17.5
	Both	8.7	11.5	14.5	22.0	29.4	13.5
All Others	Male	7.5	9.3	12.3	16.7	21.7	10.3
	Female	16.2	19.7	25.0	32.0	38.7	21.1
	Both	12.0	17.0	17.7	29.3	27.7	16.7
All Races	Male	5.5	6.8	9.2	12.7	18.2	7.6
	Female	12.2	15.2	19.2	25.9	32.8	17.9
	Both	9.1	12.2	14.7	22.7	29.2	13.8
Moderate (5–15%) Poverty Community							
White	Male	6.3	7.8	10.4	14.4	18.9	9.0
	Female	13.8	16.9	21.7	28.2	34.8	19.9
	Both	10.4	13.1	17.3	23.5	29.9	15.5
All Others	Male	8.9	11.0	14.3	18.8	23.1	11.8
	Female	18.9	22.7	28.2	35.0	40.4	25.2
	Both	13.8	17.6	21.4	28.9	36.6	19.1
All Races	Male	6.5	8.1	10.7	14.6	19.1	9.2
	Female	14.1	17.3	22.0	28.6	35.1	20.2
	Both	10.6	13.4	17.5	23.8	30.2	15.7
High (>15%) Poverty Community							
White	Male	7.5	9.3	12.2	16.3	20.3	10.5
	Female	16.2	19.6	24.7	31.1	36.5	22.1
	Both	12.4	15.2	19.7	25.9	31.1	17.3
All Others	Male	10.5	12.8	16.3	20.8	24.1	14.1
	Female	21.7	25.8	31.4	37.6	41.3	28.3
	Both	17.3	21.1	25.5	33.5	35.0	23.1
All Races	Male	7.9	9.8	12.9	16.8	20.9	11.0
	Female	17.0	20.8	25.9	32.3	37.1	23.2
	Both	13.1	16.2	20.7	27.1	31.6	18.3

which are not in the model strongly influence functional dependency.

Discussion

Using log-linear models, regression-adjusted synthetic estimates of the rates of two levels of functional dependency among the noninstitutionalized age 65 and over population were produced. Age, sex, race, and the percent of the population age 65 and over who reside in poverty were found to be significant predictors of ADL and IADL dependency among the noninstitutionalized population age 65 and over.

Introduction of a contextual variable into the regression model appears overdue given that estimated rates are substantially affected by the poverty variable. The results here, which are consistent with other researchers' work, suggest that just as poverty is a strong correlate of many unwanted problems in youth and adulthood, so too its sequelae are present in old age, manifesting as higher dependency rates.

Results here also confirm the strong relationship reported by other researchers between dependency and age, as well as the variation in age-specific rates of dependency between men and women, and Whites and all other races. While explication of the underlying determinants of these variations is beyond the scope of this paper, reconfirming their importance suggests the need for policies and research agendas sensitive to these relationships and variations. Of particular importance is the quadratic relationship between age and dependency, meaning that with each passing five-year interval rates of dependency increase at an increasing rate—a sobering prospect given the rapid expansion of the oldest old population.

The percentages generated with the regression models (Tables 2 and 3) can be multiplied by corresponding population estimates for specific geographic areas of interest to generate regression-adjusted synthetic estimates of dependency (similar to those in Tables 4 and 5) among the noninstitutionalized age 65 and over population.

Such estimates are likely to be most useful as a gauge of the size of the long-term care population in subnational areas. They may also be of use as initial building blocks for estimating demand for formal long-term care services. While functional dependency estimates will not translate directly to service demand without other important measures (i.e. income, price, preferences, and other need measures such as social support), previous research has shown that utilization of formal health care services is closely related to need.[38,39] Furthermore, the usefulness of the methods outlined here will be greatly enhanced by the 1990 US Census, which will make age, sex, race, and poverty data widely available.

Finally, it should be noted that while the analysis supports the use of these equations to produce small area estimates of functional dependency among the noninstitutionalized age 65 and over population, the quality of the small area estimates produced by them still needs to be evaluated in future research using geographic indicators (not presently available for public use) which permit comparison of synthetically produced estimates with direct estimates from adequately large samples for the same small areas. ☐

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TABLE 4—1986 Dependent Noninstitutionalized Population Age 65 and over by State: Regression-adjusted Synthetic Estimates

State	Percent Dependent			Number Dependent		
	Total	ADL	IADL	Total	ADL	IADL
District of Columbia	33.3	11.4	21.9	23,805	8,134	15,671
Mississippi	30.1	10.4	19.7	89,953	31,064	58,889
Louisiana	29.3	10.1	19.2	125,130	42,983	82,147
Alabama	28.9	9.8	19.1	136,220	46,280	89,940
Georgia	28.6	9.6	19.0	163,071	54,646	108,425
South Carolina	28.2	9.4	18.8	95,562	31,845	63,717
Missouri	28.2	9.7	18.5	180,495	61,902	118,593
Arkansas	28.1	9.7	18.5	90,470	31,139	59,331
Oklahoma	28.1	9.7	18.5	107,760	37,049	70,711
Tennessee	28.1	9.5	18.5	154,822	52,591	102,231
South Dakota	28.0	9.8	18.2	26,148	9,186	16,962
Virginia	28.0	9.5	18.6	158,247	53,509	104,738
North Carolina	28.0	9.4	18.6	195,934	65,655	130,279
Texas	27.8	9.5	18.3	409,903	139,822	270,081
Kentucky	27.7	9.5	18.2	115,895	39,612	76,283
Maine	27.6	9.5	18.1	41,482	14,291	27,191
North Dakota	27.5	9.7	17.9	22,777	7,993	14,784
West Virginia	27.3	9.3	18.0	65,472	22,317	43,155
New Mexico	26.7	9.2	17.5	36,127	12,405	23,722
Idaho	26.3	9.1	17.2	27,933	9,641	18,292
Hawaii	25.8	8.3	17.5	27,006	8,674	18,332
Nebraska	24.0	7.7	16.4	47,939	15,291	32,648
New York	24.0	7.5	16.6	521,526	162,389	359,137
Kansas	23.9	7.6	16.3	72,273	22,868	49,405
Iowa	23.7	7.5	16.2	91,976	29,141	62,835
Minnesota	23.6	7.5	16.1	114,774	36,478	78,296
Massachusetts	23.6	7.3	16.3	177,057	55,050	122,007
Maryland	23.5	7.2	16.3	103,331	31,767	71,564
Illinois	23.5	7.3	16.2	300,132	92,840	207,292
Rhode Island	23.3	7.2	16.1	31,443	9,707	21,736
Vermont	23.2	7.3	15.9	14,244	4,470	9,774
Indiana	23.1	7.1	15.9	141,704	43,800	97,904
Delaware	23.0	7.1	15.9	15,969	4,920	11,049
Connecticut	23.0	7.1	15.9	92,857	28,771	64,086
Wisconsin	23.0	7.2	15.8	136,679	42,885	93,794
New Jersey	23.0	7.1	15.9	215,410	66,269	149,141
Ohio	23.0	7.1	15.9	284,862	87,738	197,124
Pennsylvania	23.0	7.1	16.0	376,538	115,873	260,665
New Hampshire	22.9	7.1	15.8	26,237	8,155	18,082
Colorado	22.9	7.2	15.7	63,173	19,751	43,422
Michigan	22.9	7.0	15.8	229,029	70,624	158,405
Florida	22.7	7.1	15.6	426,861	133,050	293,811
Wyoming	22.6	7.1	15.5	8,928	2,814	6,114
Oregon	22.6	7.1	15.5	77,330	24,273	53,057
Washington	22.6	7.1	15.5	111,303	34,826	76,477
Montana	22.5	7.1	15.4	20,813	6,567	14,246
Utah	22.3	7.0	15.3	27,495	8,577	18,918
Arizona	21.8	6.7	15.1	82,697	25,501	57,196
Alaska	21.5	6.6	14.8	3,676	1,138	2,538
Nevada	20.4	6.2	14.2	19,249	5,845	13,404
California	19.4	5.5	13.9	521,891	147,505	374,386

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TABLE 5—1986 Dependent Noninstitutionalized Population Age 65 and over by County: Regression-adjusted Synthetic Estimates

County	Percent Dependent			Number Dependent		
	Total	ADL	IADL	Total	ADL	IADL
New Orleans, LA	31.5	10.8	20.7	19,335	6,630	12,705
Fulton, GA	31.1	10.5	20.6	18,991	6,416	12,575
Hinds, MS	30.6	10.5	20.2	8,150	2,787	5,363
Shelby, TN	30.4	10.4	20.0	23,878	8,138	15,740
Jefferson, AL	30.2	10.3	19.9	25,716	8,756	16,960
Baltimore City, MD	30.1	10.2	19.9	31,189	10,547	20,642
Philadelphia, PA	29.7	10.0	19.7	71,559	24,182	47,377
Pulaski, AR	29.0	9.8	19.1	10,363	3,520	6,843
Dade, FL	28.9	10.0	18.9	66,997	23,245	43,752
Oklahoma, OK	28.2	9.6	18.6	18,351	6,231	12,120
Greenville, SC	27.4	9.1	18.3	9,490	3,144	6,346
Marion, IN	27.3	7.8	19.6	16,774	4,757	12,017
Honolulu, HI	25.9	8.2	17.6	19,656	6,263	13,393
Denver, CO	24.5	7.7	16.8	15,395	4,838	10,557
Queens, NY	24.4	7.5	16.8	61,693	19,097	42,596
Wayne, MI	24.2	7.5	16.7	59,915	18,469	41,446
Douglas, NE	24.1	7.5	16.6	9,993	3,109	6,884
Jefferson, KY	24.1	7.4	16.7	19,164	5,889	13,275
Multnomah, OR	24.1	7.6	16.5	19,274	6,069	13,205
Hennepin, MN	24.1	7.6	16.6	25,701	8,071	17,630
Mecklenburg, NC	24.0	7.3	16.7	10,008	3,041	6,967
Los Angeles, CA	24.0	7.5	16.5	184,822	57,601	127,221
Cass, ND	23.8	7.6	16.2	2,056	655	1,401
Cook, IL	23.8	7.3	16.5	135,009	41,486	93,523
Polk, IA	23.7	7.3	16.4	7,964	2,464	5,500
Harris, TX	23.7	7.2	16.4	38,936	11,922	27,014
Providence, RI	23.6	7.3	16.3	20,369	6,300	14,069
Chittenden, VT	23.5	7.3	16.2	2,276	704	1,572
Minnehaha, SD	23.5	7.4	16.1	3,007	947	2,060
Cumberland, ME	23.5	7.3	16.2	6,954	2,171	4,783
Cuyahoga, OH	23.4	7.2	16.3	47,719	14,604	33,115
New Castle, DE	23.2	7.1	16.0	10,037	3,083	6,954
King, WA	23.2	7.2	15.9	34,343	10,715	23,628
Sedgwick, KS	23.1	7.1	16.0	9,250	2,848	6,402
New Haven, CT	23.1	7.2	16.0	24,590	7,607	16,983
Laramie, WY	23.0	7.3	15.7	1,303	411	892
Hillsborough, NH	23.0	7.1	15.9	7,336	2,259	5,077
Kanawha, WV	22.8	7.0	15.8	6,925	2,121	4,804
Salt Lake City, UT	22.5	7.0	15.5	11,630	3,613	8,017
Yellowstone, MT	22.3	7.0	15.4	2,552	794	1,758
Henrico, VA	22.3	6.7	15.6	2,813	848	1,965
Ada, ID	22.3	6.9	15.4	4,059	1,261	2,798
Bernalillo, NM	22.2	6.8	15.3	9,109	2,800	6,309
Maricopa, AZ	22.0	6.8	15.2	46,918	14,419	32,499
Anchorage, AK	20.2	6.0	14.2	1,168	346	822
Clark, NV	20.2	6.1	14.1	11,017	3,321	7,696
Middlesex, MA	20.1	5.7	14.4	32,144	9,062	23,082
Milwaukee, WI	19.9	5.6	14.3	24,335	6,812	17,523
St. Louis, MO	19.4	5.4	14.0	21,853	6,088	15,765
Bergen, NJ	18.9	5.3	13.6	21,774	6,080	15,694

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APPENDIX

To assess goodness-of-fit the model was first applied to the second half of the data set, and its goodness-of-fit was evaluated with the chi-square statistics associated with the individual parameters and with the lack-of-fit statistic.

Second, the model was applied to the entire sample to test the fit of the estimated coefficients. This was done by including an indicator variable representing the half of the data set from which each observation came, as well as all of its pairwise interactions with the other variables in the model.

Third, goodness-of-fit of the model was evaluated by comparing the similarity of the model-predicted dependency rates with their observed counterparts in the other half of the data set. In so doing, the candidate models were used to determine the predicted values of the probability of dependence for individuals in the other half of the data base. The differences between these predicted values and their true value gives a residual value for that individual. The closeness of the averages of the residuals to zero for various subgroups of individuals (e.g. males, females, different age groups, etc.) and lack of correlation of the residuals with characteristics of individuals are indicative of goodness-of-fit. In addition, Pearson correlations were evaluated for the residuals and each of the explanatory variables, and their low values supported the fit of the model.

TABLE A-1—Direct Point Estimates of the Number of Noninstitutionalized Americans Ages 65 and over Who Were Functionally Dependent in 1984 by Age, Sex, and Race

		Personal Care Dependent[a]						Mobility or Household Activity Dependent[b]					
Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
White	Male	164,644	143,520	147,240	87,750	111,319	654,473	255,589	238,009	185,456	121,775	114,223	915,052
	Female	157,176	190,273	192,626	234,942	286,274	1,061,291	608,833	629,901	668,388	479,112	422,742	2,808,976
	Both	321,820	333,793	339,866	322,692	397,593	1,715,764	864,422	867,910	853,844	600,887	536,965	3,724,028
Other	Male	20,095	15,920	27,803	17,060	12,628	93,506	34,700	35,507	12,834	12,037	6,461	101,539
	Female	27,466	29,173	32,021	24,656	30,263	143,579	88,035	129,402	93,806	60,226	33,796	405,265
	Both	47,561	45,093	59,824	41,716	42,891	237,085	122,735	164,909	106,640	72,263	40,257	506,804
All Races	Male	184,739	159,440	175,043	104,810	123,947	747,979	290,289	273,516	198,290	133,812	120,684	1,016,591
	Female	184,642	219,446	224,647	259,598	316,537	1,204,870	696,868	759,303	762,194	539,338	456,538	3,214,241
	Both	369,381	378,886	399,690	364,408	440,484	1,952,849	987,157	1,032,819	960,484	673,150	577,220	4,230,832

[a] Personal care dependent includes bathing, dressing, toileting, transferring, or eating. Individuals classified as personal care dependent may also be dependent in mobility or household activities but are counted only as personal care dependent.

[b] Mobility or household activity includes inside mobility, outside mobility, meal preparation, grocery shopping, money management, housework (heavy and light), and telephone usage. Individuals already classified and counted in this table as personal care dependent are excluded from this category.

SOURCE: 1984 National Health Interview Survey's Supplement on Aging.

TABLE A-2—Direct Point Estimates of the Percent of Noninstitutionalized Americans Ages 65 and over Who Were Functionally Dependent in 1984 by Age, Sex, and Race

		Personal Care Dependent[a]						Mobility or Household Activity Dependent[b]					
Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
White	Male	4.45	5.29	7.70	9.68	20.49	6.70	7.1	9.0	9.9	13.8	21.6	9.6
	Female	3.46	5.08	6.63	13.44	23.55	7.50	13.7	17.1	23.5	27.9	36.1	20.3
	Both	3.91	5.17	7.05	12.16	22.61	7.17	10.7	13.7	18.1	23.1	31.6	15.9
Other	Male	5.29	5.63	12.40	20.11	30.64	9.23	9.5	13.0	6.4	15.4	15.7	10.4
	Female	5.87	6.39	11.51	13.00	31.38	9.65	19.7	29.5	34.3	32.3	38.1	28.3
	Both	5.61	6.10	11.91	15.20	31.16	9.48	15.1	23.2	21.9	27.3	31.0	21.1
All Races	Male	4.53	5.32	8.19	10.58	21.20	6.93	7.3	9.3	9.5	13.9	21.2	9.7
	Female	3.69	5.22	7.06	13.40	24.13	7.70	14.2	18.4	24.5	28.3	36.2	21.0
	Both	4.06	5.26	7.51	12.44	23.23	7.34	11.1	14.6	18.5	23.5	31.5	16.4

[a] Personal care dependent includes bathing, dressing, toileting, transferring, or eating. Individuals classified as personal care dependent may also be dependent in mobility or household activities but are counted only as personal care dependent.

[b] Mobility or household activity includes inside and outside mobility, meal preparation, grocery shopping, money management, housework and laundry, or taking medications. Individuals already classified and counted in this table as personal care dependent are excluded from this category.

SOURCE: 1984 National Health Interview Survey's Supplement on Aging.

(continued)

APPENDIX (cont.)

TABLE A-3—Standard Errors for Direct Point Estimates of the Number of Noninstitutionalized Americans Ages 65 and over Who Were Functionally Dependent in 1984 by Age, Sex, and Race

		Personal Care Dependent[a]						Mobility or Household Activity Dependent[b]					
Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
White	Male	22,089	17,716	19,053	16,788	15,575	44,178	28,512	35,599	19,739	16,863	15,080	51,398
	Female	61,455	20,109	23,692	21,521	25,062	24,852	41,039	34,866	52,187	28,654	31,635	97,799
	Both	30,234	32,062	31,102	27,462	30,537	81,762	52,840	44,439	60,723	30,779	37,923	114,393
Other	Male	6,615	6,695	9,789	6,726	6,028	15,914	9,982	11,011	6,021	5,462	4,759	18,232
	Female	19,032	8,025	8,729	9,101	7,743	8,847	14,699	18,944	16,384	13,098	9,883	38,966
	Both	9,418	11,479	12,331	10,894	11,348	26,045	19,473	24,630	16,333	15,095	10,408	50,672
All Races	Male	23,550	19,188	22,393	18,136	16,076	47,292	29,841	26,794	21,340	18,231	15,813	53,851
	Female	21,067	23,577	25,280	26,080	26,048	62,634	42,659	37,894	55,004	31.530	31,851	102,984
	Both	33,080	32,690	36,685	28,888	31,919	86,074	56,564	49,549	63,438	35,726	38,704	124,479

[a] Personal care dependent includes bathing, dressing, toileting, transferring, or eating. Individuals classified as personal care dependent may also be dependent in mobility or household activities but are counted only as personal care dependent.

[b] Mobility or household activity includes inside mobility, outside mobility, meal preparation, grocery shopping, money management, housework (heavy and light), and telephone usage. Individuals already classified and counted in this table as personal care dependent are excluded from this category.

NOTE: Standard errors calculated using SAS supported procedure PROC SESUDAAN.[40]

SOURCE: 1984 National Health Interview Survey's Supplement on Aging.

TABLE A-4—Standard Errors for Direct Point Estimates of the Number of Noninstitutionalized Americans Ages 65 and over Who Were Functionally Dependent in 1984 by Age, Sex, and Race

		Personal Care Dependent[a]						Mobility or Household Activity Dependent[b]					
Race	Sex	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over	Ages 65–69	Ages 70–74	Ages 75–79	Ages 80–84	Ages 85 & Over	Ages 65 & Over
White	Male	.60	.61	.94	1.97	2.73	.45	.71	.91	.10	.19	2.70	.47
	Female	.45	.64	.69	1.23	1.68	.40	.84	.91	1.59	1.67	2.01	.62
	Both	.37	.48	.59	.98	1.48	.31	.58	.65	1.16	1.23	1.75	.41
Other	Male	1.80	2.32	4.22	6.84	11.67	1.43	2.50	3.75	2.64	6.09	9.27	1.62
	Female	1.81	2.02	3.26	3.78	8.08	1.16	2.68	3.04	4.27	5.12	8.24	1.90
	Both	1.23	1.61	2.23	3.48	7.06	.91	2.09	2.69	2.70	4.32	6.48	1.52
All Races	Male	.58	.60	.98	1.96	2.66	.43	.67	.87	.97	1.79	2.62	.45
	Female	.44	.55	.74	1.17	1.60	.37	.82	.85	1.51	1.49	1.85	.58
	Both	.37	.44	.62	.94	1.43	.30	.57	.63	1.08	1.13	1.61	.40

[a] Personal care dependent includes bathing, dressing, toileting, transferring, or eating. Individuals classified as personal care dependent may also be dependent in mobility or household activities but are counted only as personal care dependent.

[b] Mobility or household activity includes inside and outside mobility, meal preparation, grocery shopping, money management, housework and laundry, or taking medications. Individuals already classified and counted in this table as personal care dependent are excluded from this category.

NOTE: Standard errors calculated using SAS supported procedure PROC SESUDAAN.[40]

SOURCE: 1984 National Interview Survey's Supplement on Aging.

Dioxins and Dibenzofurans in Adipose Tissue of US Vietnam Veterans and Controls

ABSTRACT

The primary reason for concern about the adverse effects of exposure to Agent Orange is attributable to its toxic contaminant, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) or dioxin. We studied adipose tissues from 36 Vietnam veterans, a similar group of 79 non-Vietnam veterans, and 80 civilians; the tissue specimens were selected from the 8,000 archived tissues collected from the non-institutionalized general population by the US Environmental Protection Agency. The geometric mean (± standard deviation) dioxin levels in adipose tissue for Vietnam veterans, non-Vietnam veterans, and civilian controls were 11.7 (±1.7), 10.9 (±1.7), and 12.4 (±1.9) parts per trillion on a lipid weight basis, respectively. The mean levels for these groups were not significantly different from each other with or without adjustment for age of individuals, body mass index, and specimen collection year. In addition, none of the surrogate measures of Agent Orange exposure such as military branch, service within specific geographic region, military occupation, and troop location in relation to recorded Agent Orange spray was associated with the dioxin levels in adipose tissue of Vietnam veterans. Our results suggest that heavy exposure to Agent Orange or dioxin for most US troops was unlikely. (*Am J Public Health* 1991; 81:344-349)

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Introduction

From 1965 to 1970, the US Air Force sprayed more than 40 million liters of Agent Orange in South Vietnam.[1] Approximately two million American soldiers served in Vietnam during this period. Agent Orange was the name used for a phenoxy herbicide consisting of a mixture of 2,4-dichloro-phenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). The 2,4,5-T contained 1-50 parts per million of the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), also known as dioxin. Dioxin is extremely toxic in laboratory animals, promotes liver tumors in rats, and is teratogenic in mice.[1,2] The two parent herbicides, 2,4-D and 2,4,5-T are very short-lived in the human body and do not persist in the environment.[3] Because of these characteristics and their relatively low toxicity in humans, attention has been focused on the highly persistent and toxic chemical, dioxin.

Many Vietnam veterans believe that they were heavily exposed to Agent Orange and that the exposure is responsible for health problems such as skin rashes, rare types of cancer, and birth defects of their children. Since 1979, 200,000 Vietnam veterans have come to Department of Veterans Affairs (VA) hospitals for an Agent Orange Registry medical examination because of concerns about exposure to Agent Orange.

Two questions are paramount in dealing with the veterans' concerns. The first is whether dioxin causes birth defects, immune deficiencies, cancers, or other chronic health problems in humans. The second is whether Vietnam veterans, in general, received substantial exposure to dioxin while they served in Vietnam. This study addresses the second question.

Dioxin accumulates preferentially in the body fat of animals and man. Its half-life in humans is estimated at five to 11 years.[4-7] Among the many 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) found in the environment and in samples of human adipose tissue, only 2,3,7,8-TCDD or dioxin was present in Agent Orange.[7] Dioxin levels in adipose tissues could, therefore, serve as a biological marker of exposure to Agent Orange. In fact, several studies have reported that even after approximately 20 years, dioxin levels were elevated markedly in the adipose tissue or blood serum of Vietnam veterans who handled Agent Orange.[6-8] More recently, however, the Centers for Disease Control (CDC) reported that current serum dioxin levels of Army Vietnam combat troops did not differ significantly from those of non-Vietnam veterans and that dioxin levels in Vietnam veterans did not increase with increased exposure levels estimated from military records.[9] This study was criti-

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cized on the basis that blood specimens taken almost 20 years after exposure could not represent what happened in Vietnam and that veterans selected for the study were limited to Army enlisted men who served in only one geographic region of Vietnam.[10]

The purpose of our study was twofold: 1) to determine if a group of individuals with military service in Vietnam have significantly higher levels of dioxin in adipose tissue than either a similar group of non-Vietnam veterans or civilian peers, and 2) to determine if dioxin levels in adipose tissue were associated with specific demographic and military service characteristics.

Methods

Selection of Study Subjects

Our study used adipose tissue specimens that had been collected from the general population by the US Environmental Protection Agency (EPA). The EPA has conducted the National Human Adipose Tissue Survey (NHATS) since 1970 to monitor the human body burden of pesticides and other selected chemicals. Up to 1,000 adipose tissue specimens have been collected annually from pathologists and medical examiners across the country and analyzed by the EPA for the selected chemicals. After analysis, the unused tissue specimens were sent to a central facility to be stored at 0°C to −20°C.

The NHATS utilized a probability sample of the Standard Metropolitan Statistical Areas (SMSA) that is designated to represent a sample of the US population in terms of age, sex, and race.[11] The target population for the NHATS program was all non-institutionalized persons in the conterminous US. However, due to the invasive nature of collecting adipose tissue samples, the sampling population was limited to individuals who died from external causes (90 percent) and surgical patients (10 percent). Within each SMSA, hospitals or medical examiners were identified and asked to contribute tissue specimens according to the design specifications of age (0–14 years, 15–44 years, 45+ years), sex and race (White, non-White). Since the vast majority of Vietnam veterans were men born between 1936 and 1954, this study was restricted to specimens from men born in that period.

An Inventory File was created for the 8,000 specimens that were recorded to have an adequate amount of tissue. It was found that 528 of 8,000 specimens were from males born between 1936 and 1954. The hospitals or medical examiners who originally collected the 528 specimens were recontacted to obtain enough identifying information on the donors to determine their military service status. The collection effort yielded information for 494 or 94 percent of the 528 specimens.

The military service status for these 494 men, including any Vietnam service, was determined by reviewing records archived at the National Personnel Records Center (NPRC) in St. Louis and military records maintained at other locations. From this effort, 134 men (or 27 percent of 494) were initially found to have served in the military, 40 of whom served in Vietnam. According to the 1980 Census, one would expect about 34 percent of men in this age group to be veterans. All 40 Vietnam veterans were selected for the study. From the 94 remaining veterans, 80 were selected randomly for the non-Vietnam comparison group. Two civilians were closely matched to each Vietnam veteran by birth year (±two years) and sample collection year (±two years). Age and sample collection year were considered important matching variables because of probable accumulation of dioxin in the body with each year of exposure and the possibility of degradation of fat or dioxin while in storage. All adipose tissue specimens were analyzed during 1987. Demographic data were taken from the NHATS file and the official death certificates. Body mass index (BMI) was calculated from weight and height as follows: BMI = weight in Kg/height in m^2.

Determination of Opportunity for Agent Orange Exposure

A precise estimate of the exposure of each Vietnam veteran to Agent Orange is not considered feasible based on either military records or self-reported data. In this study the probable opportunity for exposure was determined from the following: branch of service, military occupational specialty code (MOSC), and location of the individual's unit in Vietnam in relation to recorded Agent Orange spray. Ground troops in Vietnam might have had a higher probability of contact with Agent Orange than other Vietnam veterans due to the nature of their military operations. Ground troops engaged in combat were assumed more likely to be in herbicide-sprayed areas. As another surrogate for exposure, a veteran's military unit was assigned to one of the four broad military regions in Vietnam. According to the records of the US Air Force Ranch Hand Operation, 20 million liters of Agent Orange were sprayed in Military Region III from 1965 to 1970. During the same period, Military Regions II, I, and IV received 9.5, 8.3, and 4.5 million liters, respectively. Finally, troop locations (company size units) were determined on a 100-meter grid map of Vietnam at intervals of 90 days or less. Computer matching of troop location with respect to time and distance from recorded herbicide spray tracts was carried out using the HERBS tape and services HERB tape databases. The HERBS tape contained information on most of the herbicide missions flown by fixed-wing aircraft from 1965 to 1971, and on crop destruction missions flown by helicopter between 1968 and 1971. The tape contained information on the type of herbicide, gallons, dates, and where spray runs started and ended. Services HERBS Tape prepared by US Army and Joint Services Environmental Support Group identified and documented an additional six million liters of herbicide sprayed mainly by Army personnel around the perimeter of base camps, fire bases, air bases, and other fixed military installations. The opportunity for Agent Orange exposure was determined in two ways: an individual's company was ever located either within two kilometers (km) of a recorded Agent Orange spray tract within three days of application or within eight km of a spray tract within 90 days application.

Laboratory Analysis

Specimens from the three groups were assigned randomly to one of 20 batches. Each batch typically consisted of 10 study specimens and four quality control (QC) samples. The QC samples provided data on method accuracy and precision. In addition, the external quality control audit samples were prepared by another laboratory and incorporated as blind samples into the various batches. Study specimens and QC samples were coded with a unique laboratory number and submitted to the analysts as blind samples. Following sample cleanup and preparation, instrumental analyses were achieved using a high resolution gas chromatograph coupled to a high resolution double-focusing mass spectrometer. Overall method accuracy and precision for 2,3,7,8-TCDD analyses of spiked lipid samples were 113 percent recovery and 8.8 percent coefficient of variation.

The analytical protocol provided for the detection and quantitative determination of 17 congeners of 2,3,7,8-substituted

TABLE 1—Distribution of 2,3,7,8-TCDD Levels in Adipose Tissue by Military Service Status, in pg/g of the Total Extractable Lipid (ppt)

Status	N	Arithmetic Mean ± SD[a]	Geometric Mean	Percentile 25th	Percentile 50th (median)	Percentile 75th	Percentile 90th	Percentile 95th
Vietnam Veterans	36[b]	13.4 ± 7.4	11.7	7.8	10.0	17.3	26.8	30.4
Non-Vietnam Veterans	79[c]	12.5 ± 7.2	10.9	7.6	11.4	14.8	19.8	25.3
Civilians	80	15.8 ± 14.5[d]	12.4	7.9	11.8	18.0	30.5	43.4

[a] Standard deviation

[b] Four of the 40 men initially classified as having served in Vietnam were excluded from analysis because two veterans' specimens had less than 20% extractable lipid content, one veteran did not have adequate amount of tissue for analysis, and one veteran served only in Thailand.

[c] One of the 80 men initially classified as having served in the military was excluded because his military service could not be documented unequivocally.

[d] The large standard deviation was attributed to an outlier with a value of 106. The value was verified. The occupational history of this individual is unknown. He was listed as a "laborer" on his death certificate. Analysis conducted without this value resulted in an arithmetic mean of 14.7 (± 10.3) and a geometric mean of 12.2. There was still no statistically significant difference between the groups (p = 0.49).

polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF). The minimum measurable concentration ranged from 1 picogram per gram (pg/g) for 2,3,7,8-TCDD and 2,3,7,8-TCDF, to 5 pg/g for OCDD and OCDF based on a 10 gram aliquot of human adipose tissue. This protocol was evaluated for method performance prior to being used in this study.[12]

Statistical Considerations

Multiple comparisons and testing for differences were done by using the F test in one way analysis of variance (ANOVA) and analysis of covariance with adjustments for demographic variables such as age, collection year, and body mass index.[13] A paired t-test was conducted to compare the means of Vietnam veterans with their matched civilian controls.[14] In all analyses, the dioxin values were transformed to a natural logarithmic scale because the dioxin values were found to have approximately log-normal distributions in this study and another study.[15]

A stepwise linear regression model was also used to determine whether dioxin levels were associated with demographic and military service characteristics.[16] Factors considered *a priori* as covariates were age, adipose tissue sample collection year, race, and body mass index. A regression model specific to Vietnam veterans included such covariates as military occupation, calendar year of tour in Vietnam, geographic region in Vietnam, time of and distance from recorded Agent Orange spray, and adipose tissue sample collection year.

Results

Table 1 presents the arithmetic and geometric means, and various percentile values for dioxin for the three study groups. One-way analysis of variance did not demonstrate differences in the mean dioxin levels among groups (p = 0.35). Analysis of covariance, testing the effect of Vietnam service on dioxin levels after adjusting for age, sample collection year, or body mass index did not indicate an association between service in Vietnam and dioxin levels. A paired t-test between Vietnam veterans and their matched civilian pairs did not show a difference in mean dioxin levels (95% confidence interval for the difference between two means = −1.32,1.16).

For Vietnam veterans, dioxin levels were also evaluated by four factors related to the likelihood of Agent Orange exposure (Table 2). None of the surrogate measures of Agent Orange exposure was associated with the dioxin levels in adipose tissue of Vietnam veterans. Furthermore, the mean dioxin level of seven Vietnam veterans whose specimens were taken within four years (less than one dioxin half-life estimated for humans) since their last service in Vietnam were compared to 19 non-Vietnam veterans whose tissue specimen were collected on or before 1974 (the last sample collection year for the seven Vietnam veterans), and also to their matched civilian pairs. The geometric mean dioxin levels (± standard deviation) for the Vietnam group (n = 7), non-Vietnam veteran group (n = 19), and civilian controls (n = 14) were at the levels of 16.6 (±1.6), 15.5 (±1.5), and 18.4 (±1.6) parts per trillion (ppt), respectively. There was no difference among the means (p = 0.56). The 95% CI for a mean dioxin difference between Vietnam veterans and civilian controls were −1.59 and 1.31. Stepwise linear regression analysis for 36 Vietnam veterans indicated that Vietnam service characteristics could account for only 14 percent of the variation in dioxin levels (p = 0.3), whereas collection year alone could account for 21 percent of variance (p = 0.005). Five other 2,3,7,8-substituted dioxins and 10 other dibenzofurans were measured and their mean levels were calculated from specimens with levels above the detection limit (Table 3). There were no group differences in the mean level of any of the dioxin congeners. The differences in TCDD levels in the three groups were also evaluated while adjusting for levels of other 2,3,7,8-substituted dioxin congeners not found in Agent Orange by a stepwise multiple regression technique. TCDD levels were taken as the dependent variable and Vietnam service status and other dioxin congener levels as independent variables. There was a significant association between the TCDD levels and the levels of PCDD congeners ($R^2 = 0.54$, p = 0.0001), but not with the Vietnam service status ($R^2 = 0.0025$, p = 0.3).

The levels of dioxins increased with an increase in the number of chlorine except for 1,2,3,7,8,9-HxCDD. Levels of dibenzofurans were always lower than their dioxin counterparts. In each study group, the levels of dioxin tended to be inversely related to the specimen collection year, i.e. the earlier the collection year, the higher the dioxin levels (p = 0.0001, n = 195).

Discussion

In this study, military service in Vietnam was not associated with elevated dioxin levels in adipose tissue with or without adjustment for demographic variables. In addition, no Vietnam service characteristics measured singularly or in combination was a good predictor of dioxin levels in adipose tissue. There were no consistent trends in the dioxin levels ac-

TABLE 2—Geometric Mean 2,3,7,8-TCDD Levels in Adipose Tissue by Vietnam Service Characteristics, in pg/g of the Total Extractable Lipid (ppt)

Service Characteristics	No. of Vietnam Veterans	2,3,7,8-TCDD	
		Mean	SD[a]
Branch			
Army	20	11.6	1.7
Marine	6	12.3	1.8
Air Force	1	6.7	
Navy	9	12.4	1.5
MOSC[b]			
Non-Combat	24	11.1	1.7
Combat	12	13.1	1.6
Military Region[c]			
I Corp	11	12.4	1.6
II Corp	4	6.9	1.3
III Corp	9	11.9	1.9
IV Corp	3	14.3	1.9
Sea Duty	8	13.3	1.4
Time and Distance From[d] Recorded Herbicide Spray			
a. 3 days/2 KM			
no	31	11.5	1.7
yes	4	14.3	1.6
b. 90 days/8 KM			
no	16	11.8	1.5
yes	19	11.8	1.8

[a] Standard deviation
[b] Military Occupation Specialty Code (MOSC)
[c] Missing Military Region information for one veteran
[d] Missing information on time and distance from recorded herbicide spray for one veteran due to unknown unit location

cording to the surrogate measures of Agent Orange exposure. The mean levels of dioxin did rise slightly with combat MOSC and having been within three days/two km of sprayed areas. But the other two surrogates, branch of service and service location in Vietnam, were not associated with the dioxin levels. The small magnitude of the mean difference and the variation within each group suggest that the small difference in mean values could have been easily due to the sampling and measurement variation.

Analyses of adipose tissue from the general population of industrialized countries have indicated the presence of a number of 2,3,7,8-substituted dioxins and dibenzofurans at ppt level.[17–21] These dioxins and dibenzofurans could have originated from a number of sources: incineration of municipal waste and wood products; manufacturing, use and disposal of pesticides, herbicides and wood preservatives; and PCBs from electric transformers and capacitors. Because 2,3,7,8-TCDD was the only congener found in Agent Orange as a contaminant[1,7] knowing the levels of other dioxins and dibenzofurans would help determine whether TCDD levels in adipose tissue of Vietnam veterans were the result of Agent Orange exposure in Vietnam or exposure to other sources. For example, if most dioxins and dibenzofurans as well as 2,3,7,8-TCDD levels were found to be elevated among Vietnam veterans, contribution from sources other than Agent Orange should not be ruled out. However, if only the 2,3,7,8-TCDD level remained elevated and other PCDD levels were comparable to the comparison groups, Agent Orange would be considered as the contributor. There were no group differences in the mean levels of any PCDD congeners. The lack of group differences suggested that sources other than Agent Orange may have contributed to the Vietnam veterans' levels of 2,3,7,8-TCDD. In a study by Kahn, *et al*,[7] of 10 Vietnam veterans with heavy potential for exposure to Agent Orange (e.g. Ranch Hand personnel, Army Chemical Corps specialists), the levels of 12 other 2,3,7,8-substituted dioxins and dibenzofurans were similar to the levels found among 10 Vietnam veteran controls and seven non-Vietnam veteran controls. Only 2,3,7,8-TCDD levels were elevated approximately 10-fold among Vietnam veterans with a heavy exposure potential.

This study may have failed to detect a small difference in mean dioxin levels among groups because of the relatively small sample size. The study had an adequate statistical power (90 percent) to detect a mean difference of 5 ppt or more between groups. Elimination of dioxin from the body after Vietnam service is an unlikely explanation because dioxin levels of seven Vietnam veterans whose specimens were taken within four years from their return from Vietnam (which was considerably less than the estimated half-life of dioxin in humans) were not significantly different from their appropriate comparison groups.

Although the NHATS sampling scheme was designed to collect a representative sample of the SMSA in terms of age, sex and race, subjects selected for the study may not have represented their respective groups for several reasons. First, over 90 percent of the NHATS sample were collected from deceased persons whose death in most instances were due to traumatic injury. Second, tissue samples for this study were selected from the archived NHATS specimens rather than original NHATS samples. Third, 6 percent of the men who were eligible for the study had to be excluded because of missing personal identifiers. Despite these problems, demographic and military characteristics of the Vietnam veterans selected for the study did not differ substantially from the overall Vietnam veteran population. They were predominantly white (75 percent), draft eligible during the Vietnam war (age 18 to 25), enlisted men (89 percent), who served in the Army and Marine Corps (72 percent) with military occupational specialties related to combat support roles (67 percent). None of the Vietnam veterans in the study had a record of routinely handling or spraying Agent Orange.

The mean background levels of dioxin reported here were generally higher than the values reported by others.[6–9] It is unlikely that this difference is due solely to an interlaboratory variation. Our laboratory (Midwest Research Institute) participated in an interlaboratory validation study for dioxin measurement and produced a satisfactory result. Furthermore, external quality control audit samples prepared by the Battelle Columbus Division were incorporated as blind samples into the various batches and analyzed for dioxin and dibenzofuran congeners. The analytical results were found to be acceptable. We believe that the difference in sampling years between this study and several other studies could account for the higher values reported in our study. We found that the dioxin levels in adipose tis-

TABLE 3—Arithmetic Mean Levels of Dioxins and Furans Detected in Adipose Tissue by Military Service Status, in pg/g of the Total Extractable Lipid (ppt)

Chemicals	Status		
	Vietnam Veterans	Non-Vietnam Veterans	Civilians
Dioxins			
2378-TCDD	13.4 (36)*	12.5 (79)	15.8 (80)
12378-PeCDD	20.6 (36)	18.3 (78)	18.3 (80)
123478/123678-HxCDD	170.4 (36)	152.9 (79)	165.1 (80)
123789-HxCDD	19.4 (35)	17.2 (79)	17.9 (79)
1234678-HpCDD	276.2 (36)	244.6 (79)	300.3 (80)
OCDD	1261.8 (36)	1108.9 (79)	1392.9 (80)
Furans			
2378-TCDF	2.9 (25)	2.4 (52)	3.3 (51)
12378-PeCDF	1.7 (8)	1.1 (17)	1.9 (16)
23478-PeCDF	23.1 (35)	22.2 (78)	23.3 (80)
123478-HxCDF	21.5 (36)	19.3 (78)	23.2 (79)
123678-HxCDF	10.7 (34)	9.9 (77)	12.0 (79)
234678-HxCDF	3.8 (26)	3.2 (73)	3.6 (78)
123789-HxCDF	1.5 (3)	0.9 (2)	0.9 (4)
1234678-HpCDF	37.4 (36)	32.9 (79)	39.1 (80)
1234789-HpCDF	2.2 (14)	1.9 (35)	2.2 (41)
OCDF	3.6 (27)	4.5 (54)	3.4 (60)

*the number in parentheses represent the number of cases in that category

sue were significantly associated with the sample collection year (p = 0.0001), the earlier the collection year, the higher the levels of dioxin irrespective of veteran status. In fact, this general trend was observed for other dioxins. The median sample collection year in our study was 1978, whereas in other studies the specimens were mostly collected in mid 1980s or later. The observed dioxin decline from 1971 to 1982 is consistent with the general trend for chlorinated hydrocarbon chemical compounds in human adipose tissue. The US EPA's National Human Adipose Tissue Survey Program indicates that the median levels of BHC, HCB, and PCB had been steadily decreasing over time between 1970 and 1983.[11] In Sweden the levels of dioxin and dibenzofurans in human milk decreased significantly from 1972 to 1985.[22] The Swedish authors attributed the decline to the reduction in use of certain organochlorine compounds such as PCBs, PCP and 2,4,5-T. A study involving a large sample of specimens representative of the US population will be needed to confirm this observation.

We concluded that the results of our study did not support the hypothesis that most US troops were heavily exposed to dioxin in Vietnam. Furthermore, none of the surrogate measures of Agent Orange exposure based on military service characteristics was associated with the dioxin levels in adipose tissue of Vietnam veterans. These results are consistent with those of CDC[9] and not inconsistent with Kahn, *et al*,[7] and Schecter, *et al.*[8] ☐

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Kellogg Grant to Strengthen Community Health Services

A grant of $1.2 million has been awarded to the Colleges of Nursing and Medicine at the University of Illinois at Chicago (UIC) by the W. K. Kellogg Foundation to strengthen community-based health service. Emphasizing leadership training for project directors, community members and health care professionals, the project will bring together community residents and health care professionals to create partnerships in advancing leadership in community-based primary health care.

Both classroom instruction and practical hands-on experience at community-based primary health care sites will be offered. UIC faculty and community leaders will serve as mentors for program participants.

For more information, contact Susan Poslusny, Office of Leadership for Primary Health Care in Urban Communities, College of Nursing (m/c 802), the University of Illinois at Chicago, 845 S. Damen, Chicago, IL 60612; (312) 413-0068.

The UCLA Population Studies of CORD: X. A Cohort Study of Changes in Respiratory Function Associated with Chronic Exposure to SO_x, NO_x, and Hydrocarbons

Roger Detels, MD, MS, Donald P. Tashkin, MD, James W. Sayre, DrPH, Stanley N. Rokaw, MD, Frank J. Massey, Jr., PhD, Anne H. Coulson, and David H. Wegman, MD

ABSTRACT

Two never-smoking cohorts in Southern California, one in Lancaster (N = 2340) exposed only to moderate levels of oxidants and the other in Long Beach (N = 1326) exposed to high levels of SO_x, NO_2, hydrocarbons and particulates completed spirometry and the single-breath nitrogen test five to six years apart. Forty-seven percent and 45 percent of the participants were retested. Mean results at baseline for those tested and not retested were similar. Loss to follow-up was primarily due to moving (39 percent and 47 percent). Every difference of consequence indicated greater deterioration in lung function in Long Beach. The level of significance of the difference was greatest, even in the youngest age groups, for $\Delta N_{2_{750-1250}}$, suggesting that the earliest site of impairment may occur in the small airways. Greater deterioration in spirometric parameters was observed in every age group in Long Beach females above seven years of age at baseline and in Long Beach males above 15 years of age, suggesting that chronic exposure to the pollutant mix occurring in Long Beach ultimately adversely affects the large airways as well as small airways. (*Am J Public Health* 1991;81:350–359)

Introduction

The relationship of temporary high levels of SO_x and particulates to health has been well documented by episodes such as those reported in the Meuse Valley, Donora, and London. A higher prevalence of symptoms of chronic obstructive respiratory disease and/or impaired lung function has been reported in cross-sectional studies in areas exposed to high levels of SO_x, NO_x, and/or particulates,[1–4] while in other studies a relationship has not been observed.[5] A number of cohort studies have also been completed, especially in adults.[6–14] The major problems encountered in cohort studies have been maintaining continuous measurement of pollutant levels and controlling for confounding factors which may change. These studies have depended primarily on the use of spirometry for measurement of lung function because of the difficulties associated with doing population studies using possibly more sensitive tests such as the single-breath nitrogen test. There is considerable evidence from experimental studies of both animals and humans that SO_2 and particulate sulfates may be responsible for bronchoconstriction,[15–24] possibly mediated through histamine release and subsequent action on bronchial smooth muscle.[25] A number of these studies have shown such effects at concentrations that occur in ambient air in some urban areas in the United States.

Previously, we reported a greater rate of deterioration in spirometric indices of the single-breath nitrogen test in residents chronically exposed to high levels of oxidants, oxides of nitrogen, sulfate, and particulates compared to an area exposed to low levels of these pollutants.[26]

In this paper we compare changes over a five- to six-year period in spirometric tests and the single-breath nitrogen test in never-smoking residents of an area chronically exposed to high levels of SO_2, sulfates, NO_x, and hydrocarbons but low levels of oxidants with changes to those in residents of another area exposed to low levels of these pollutants to which comparisons to the oxidant-polluted community were made in the previous paper.

Methods

Establishment of Cohorts

Study areas were selected in Lancaster (located 75 miles north of downtown Los Angeles) which historically has been chronically exposed to moderate levels of photochemical oxidants and very low levels of other pollutants and in Long

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TABLE 1—Demographic Characteristics of Study Census Tracts in Lancaster and Long Beach[*]

Characteristics	Lancaster	Long Beach
Total residents, all ages	7,069	4,992
White (non-Spanish-surnamed) (%)	6,430 (91.0)	4,939 (98.9)
Spanish-surnamed (%)	434 (6.1)	0 (0.0)
Black (%)	91 (1.3)	3 (0.1)
Other (%)	114 (1.6)	50 (1.0)
Total 7+ years of age	6,121	4,691
Median income	$11,631	$11,474
Number of housing units	2,238	2,197
Proportion of homeowners (%)	63	64
Median home value	$18,600	$23,400

[*] According to the 1970 census.

Beach (located approximately 30 miles southwest of downtown Los Angeles) which has been chronically exposed to high levels of sulfur dioxide, sulfates, oxides of nitrogen, and probably hydrocarbons. Using 1970 census information, study areas were selected that were demographically similar, each of which contained an established air quality monitoring station. A comparison of the demographic characteristics of the two study areas according to the 1970 census is shown in Table 1. Although the Long Beach study area included a lower proportion of non-Whites, all comparisons in this paper are restricted to White, non-Spanish-surnamed residents who never smoked in order to reduce non-comparability between the cohorts. Participants were considered "never smokers" if they had never smoked more than one cigarette per day. Participants who reported smoking at either the baseline or follow-up examination were excluded from the analysis.

Cross-sectional studies conducted in the Lancaster study area in 1973–74 and in the Long Beach study area in 1974–75 demonstrated poorer lung-function in Long Beach.[27] Concurrent testing was not possible due to funding limitations. Pollutant levels in Long Beach, however, remained similar over this period of time. Details of the recruitment of the study areas have been reported previously.[26–30] Briefly, all the heads of households were identified through reverse telephone directories and voter registration files. Before explanatory letters were sent out, descriptive information regarding the program was presented in the local media. Following the mailing of individualized letters, a neighborhood representative set up an appointment to complete a roster of all household members seven years of age and older and to arrange appointments for lung function testing at the Mobile Lung Function Laboratory, which was located within walking distance.

At the Mobile Laboratory, an interview schedule modified from the National Heart, Lung and Blood Institute Questionnaire was administered; this contained questions concerning respiratory symptoms, and history of respiratory disease, occupation, smoking, and residence. Height and weight were recorded, and the following pulmonary function tests were done: body plethysmography; single-breath nitrogen washout curve, including calculation of $\Delta N_{2_{750-1250}}$[*] and closing volume; and electronic spirometry measurement with permanent recording of the entire maximal expiratory flow volume relationship on computer tape. The test equipment used was the same for all the testing except for the recorder for the spirometer. The new recorder, however, was thoroughly calibrated to the old recorder before being put into use. Details of the instrumentation used and the procedures followed are contained in previous papers.[28,29] Results of body plethysmographic tests were inconsistent at baseline; thus, changes in these tests could not be determined with confidence. Details of the procedures for administering the single-breath nitrogen test and spirometry are given in Appendix A.

Retesting of the Cohorts

Approximately five years in Lancaster and six years in Long Beach after the baseline studies, retesting in each of the study areas was completed (1978–79 in Lancaster and 1980–81 in Long Beach). Results, however, have all been expressed as annualized rates of change. In the interval between baseline testing and retesting, addresses had been updated through periodic mailings to all participants. Study participants were recontacted and invited to be retested in the same month in which they had originally been tested. Individuals who had moved but remained within a reasonable distance were also encouraged to undergo retesting at the Mobile Laboratory. Intensive efforts were made to persuade all participants to be retested, including call back within one day of individuals who did not keep their appointments at the Mobile Lung Function Laboratory. The procedures for retesting were identical to those used at baseline; the tests were administered in the same sequence and in the same manner.

Individuals who had moved out of the original study area were requested to undergo retesting at the Mobile Laboratory if they visited the Southern California area. Participants who had moved outside of the study area to a known address and who could not be retested were asked to complete a brief questionnaire on respiratory symptoms, smoking, and reasons for moving from the study area, including a final question that asked if the reason for moving was related to respiratory problems.

Validation and Quality Control

Procedures were implemented to calibrate and maintain the reliability of the lung function tests and to assess the effects of concurrent levels of air pollutants. These have been described in detail previously.[29,31] Briefly, they included the following:

Calibration: At the beginning of the testing period in each area the results of lung function testing in the Mobile Laboratory were compared with results obtained from the UCLA (University of California at Los Angeles) Pulmonary Function Laboratory on 10 to 20 participants who were tested on the same day in both laboratories in a randomized sequence. At the beginning of each day's testing in the field and at regular intervals during the testing, the test equipment was recalibrated using standard procedures. In addition, calibration values were recorded on computer tape and evaluated at the end of each test day at UCLA. The Mobile Laboratory was immediately notified of any signs of error or "drift" so that if needed, the instruments could be adjusted before testing commenced the next day. Individuals tested the previous day were

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[*] Change in the nitrogen concentration between 750 and 1250 cc of expired air.

TABLE 2—Average Number of Days on which Specified Pollutants Were Above California Ambient Air Quality Standards and Means of Daily Peak Hourly Values, 1972–81

Pollutant	Lancaster	Long Beach
SO_2		
Days ≥ 0.05 ppm recorded 1978–81*	0	5
mean (ppm)	.01	.04
Oxidants		
Days ≥ 0.08 ppm for 1972–77, ≥ 0.10 ppm for 1978–81	92	18
mean (ppm)	.07	.04
NO_2		
Days ≥ 0.25 ppm	0	23
mean (ppm)	.03	.11
SO_4		
Days (not recorded)	—	—
mean ($\mu g/m^3$, 24 hour totals measured every 6th day, 1977–81)	4.3 (4.3)**	11.3 (11.6)**
Total Suspended Particulates ($\mu g/m^3$)		
Days ≥ 100 $\mu g/m^3$:		
recorded Lancaster 1978–81	18 (19)**	—
recorded Long Beach 1976–81	—	27 (24)**
annual geometric mean ($\mu g/m^3$)	85 (76.1)**	101 (98.6)**

*24 hour standard
**median value

asked to undergo retesting; results for those not retested were deleted.

Reliability and Validity: The reliability of the test procedures was evaluated by requesting every tenth individual completing lung function testing to undergo repeat lung function testing within 20 minutes and comparing the results. In addition, a 3 percent probability sample of participants was asked to undergo additional testing at the UCLA Pulmonary Function Laboratory, usually within two to three months of field testing. The results of the tests in the two laboratories were compared.[26,29]

Effect of Concurrent Pollutant Levels: The possible effect of levels of air pollutants on the day of testing was evaluated by comparing lung function test results in 40 participants in Lancaster and 35 participants in Long Beach tested three times at four-month intervals in each study area. In addition, O/P (observed/predicted — adjusted for age, height, and weight) forced expiratory volume in one second (FEV_1) for all of the adult participants retested was analyzed relative to the level of pollutants recorded for the day on which their test was performed.[30]

Levels of Air Pollutants

Monitoring stations of the Southern California Air Quality Monitoring District located in the two study areas continuously recorded levels of total oxidants, nitric oxide, nitrogen dioxide, total oxides of nitrogen, total hydrocarbons (Lancaster only), and sulfur dioxide.[31] In addition, 24-hour totals for total suspended particulates (TSP) and for sulfates (at six-day intervals) were monitored. The maximum hourly level for oxidants, SO_2 and NO_x, and the 24-hour total for TSP and SO_4, as recorded at the respective monitoring station on the day of testing, were attached to each individual's computer record. All measurements met both the California and federal Environmental Protection Agency guidelines for acceptability of testing procedures for these pollutants.

Results

Levels of Pollutants during the Study Period

The annual means of the daily peak hourly values for SO_2, oxidants, NO_2, and of the 24-hour total value for SO_4 and TSP over the 10-year period are shown in Table 2. The table also gives the average number of days per year on which SO_2, oxidants, NO_2, and TSP exceeded the California ambient air quality standard. Days exceeding these levels were not recorded for all years between 1972 and 1981.[31,32] The years contributing to the determination of the mean number of days are given separately for each pollutant. In terms of both days above California ambient air quality standards and means of the daily peak hourly levels, the largest differences in recorded pollutants were in levels of NO_2. Levels of all indicated pollutants except oxidants, however, were higher in Long Beach. On the other hand, there was a five-fold greater number of days on which oxidants exceeded 0.08 or 0.10 ppm in Lancaster, but less than a two-fold difference in the annual means of the daily peak hourly levels between the two communities. Although the level of oxidants in Lancaster was lower than in most other areas of the Southern California air basin, it was nonetheless higher than in most urban areas in the United States. Unfortunately, levels of hydrocarbons were not measured at the Long Beach monitoring station, but the location of the study area directly downwind from the major oil refining area in Los Angeles and the results of interpolation from adjacent monitoring stations suggest that levels of hydrocarbons were also very high in the Long Beach study area.

Response Rates

Response rates for the two cohorts are given in Table 3. The proportion remaining in the study area who completed all of the lung function tests was reasonably high in both areas (75 percent and 77 percent). An additional 6 percent and 9 percent, respectively, completed only the questionnaire. One percent of participants in both areas were known to have died. The major problem in follow-up was the high proportion of individuals who moved out of the study area: 39 percent (910/2340) in Lancaster and 47 percent (629/1326) in Long Beach. In Lancaster, only 12 percent (270/2340) and in Long Beach only 7 percent (94/1326) of participants refused to be retested. The overall retest rate, excluding deaths, for persons completing *all* lung function tests was 47 percent for Lancaster and 45 percent for Long Beach.

The proportions retested, stratified by age, sex, and place of residence, are given in Table 4. The proportion retested tended to be lower for individuals who were 11–24 years of age at baseline testing, a finding not unexpected in this highly mobile age group leaving home for college and jobs over the five- to six-year interval between baseline testing and retesting.

Because the overall retest rate was not as high as we would have liked, a comparison was made in Table 5 of the lung function test results at baseline among those who completed retesting and those who did not. The high mean observed/predicted values at baseline for those retested reflects the fact that they repre-

TABLE 3—Retest Status of Never Smokers 7–59 Years of Age at Baseline

		Retested						Not Retested			
		Lung Function Test		Questionnaire Only		Deaths		Refused		Lost	
Residence at Baseline	Total Tested at Baseline N	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Lancaster											
Study area	1430	1061	(74)	80	(6)	19	(1)	270	(19)	—	—
Moved	910	38	(4)	325	(36)			—	—	547	(60)
Total	2340	1099	(47)			19	(1)				
Long Beach											
Study area	697	523	(75)	62	(9)	18	(3)	94	(13)	—	—
Moved	629	63	(10)	136	(21)			—	—	430	(68)
Total	1326	586	(44)			18	(1)				

TABLE 4—Percent of Never Smokers* Retested, Stratified by Age, Sex, and Place of Residence

	Lancaster		Long Beach	
Sex/Age (years)†	Tested at Baseline N	% Retested	Tested at Baseline N	% Retested
Males				
7–10	210	50	87	40
11–14	217	47	67	27
15–18	140	26	50	32
19–24	61	38	63	38
25–59	262	54	238	53
Females				
7–10	162	46	77	44
11–14	207	51	73	36
15–18	158	35	52	39
19–24	82	37	89	42
25–59	482	55	401	48

*White, non-Spanish-surnamed only, 7–59 years of age at baseline; had not changed job or residence because of a respiratory problem; FEV_1 exists at both times.

†Age at baseline.

sent volunteers who survived for five to six years and were still willing to be retested. Thus, the mean of their observed/predicted test performance at baseline does not reflect the mean for the entire group tested at baseline.

Validity of Results

The mean test/retest results for those 10 percent immediately retested were within 5 percent for the major spirometric indices. Regression analysis of the level of air pollutant on day of testing and the mean test value for FEV_1 for that day for all participants revealed no statistically significant correlations. Of the 24 comparisons made of results of FVC, FEV_1, FEF_{25-75}, FEF_{50-75}, $\Delta N_{2_{750-1250}}$, and closing volume in the two groups of participants tested at different seasons of the year, only one, $\Delta N_{2_{750-1250}}$, was significant at the $p < 0.04$ level; equivalent to chance for this number of comparisons. Mean test results in the cohort retested in three different seasons were not significantly different.

An estimate of the possible impact of errors resulting from the testing procedures in the mobile lung function laboratory was calculated by comparing the results of FEV_1 in the 3 percent probability sample of adults tested in both the mobile and the UCLA lung function laboratories. (Levels of pollution at UCLA fall between those in Lancaster and Long Beach except that the levels of oxidants are higher at UCLA than in either study area.) The mean interval between testing in the mobile and UCLA laboratories was several months.

The difference between FEV_1 values at the Mobile Laboratory were greater at T_2 (retesting) than at T_1 (baseline) in both communities although mobile laboratory values were lower at both examinations. If the UCLA laboratory results represented the true values, then the greater inter-laboratory differences at T_2 than at T_1 suggest that the annual decline in FEV_1 as measured in the field laboratory might have been exaggerated. Furthermore, comparison between the two communities of the inter-laboratory differences at T_2 versus T_1 suggests that this potential exaggeration of the annual decrement in FEV_1 was slightly greater in Long Beach (−13 ml/year, SE ± 7 ml/year) than in Lancaster (−2 ml/year, SE ± 7 ml/year). These decrements were not statistically different. Further, these differences observed in the 3 percent probability sample may not have existed in the entire group tested. The response rate for retesting of the 3 percent probability sample at T_2 was less than 50 percent.

Changes in Lung Function Tests

The means of the individual changes in tests are shown in Table 6A, for males and females 25–59 years of age, and stratified into five age groups for males (Table 6B) and females (Table 6C) 7–24 years of age at baseline. Non-adults were stratified to separate the growth phase of childhood from the declining trend in lung function which begins in late adolescence, as we have reported previously.[33] The levels of significance of differences between results in the two areas are shown in Table 7 for those age-and-sex-specific groups in which the probability was less than .05.

Changes for $\Delta N_{2_{750-1250}}$ and the spirometric indices except V_{75} were significantly worse in Long Beach participants 25–59 years. The level of significance for the difference in baseline and follow-up test results was highest for the single-breath nitrogen test. The levels of signifi-

TABLE 5—Means and Standard Errors of Spirometric and $\Delta N_{2750-1250}$ Tests at Baseline for Never Smokers Tested and Not Retested*

Test/Unit/ Residence	Retested		Died	Not Retested
	Lung Function Tests	Questionnaire only		
Number†				
Lancaster	829	311	19	740
Long Beach	499	156	18	516
FEV_1 (0/P%)**				
Lancaster	100 ± 0.5	100 ± 1.0	87 ± 4.8	99 ± .84
Long Beach	103 ± 0.7	101 ± 1.6	90 ± 6.5	101 ± 1.05
$FEF_{25-75\%}$ (0/P%)**				
Lancaster	92 ± 1.7	96 ± 2.6	100 ± 6.8	91 ± 2.21
Long Beach	89 ± 2.0	94 ± 4.3	91 ± 11.7	85 ± 2.99
$\dot{V}_{50}$ (1/sec)				
Lancaster	4.1 ± 0.06	4.3 ± 0.09	4.4 ± 0.40	4.2 ± .08
Long Beach	4.1 ± 0.07	4.4 ± 0.12	4.4 ± 0.49	4.1 ± .12
$\dot{V}_{75}$ (1/sec)				
Lancaster	1.7 ± 0.03	1.7 ± 0.04	1.8 ± 0.18	1.7 ± .04
Long Beach	1.5 ± 0.04	1.7 ± 0.07	1.6 ± 0.22	1.4 ± .06
$\Delta N_{2750-1250}$ (%)				
Lancaster	0.71 ± 0.03	0.75 ± 0.04	1.33 ± 0.18	.79 ± .09
Long Beach	0.94 ± 0.04	0.73 ± 0.05	0.81 ± 0.17	.91 ± .05

*White, non-Spanish-surnamed only; 7–59 years of age at baseline; had not changed job or residence because of a respiratory problem.
†Minimum number in groups.
**Expected values derived from previously reported equations (reference 28).

TABLE 6A—Means of Annual Change in Lung Function Tests Results between Baseline and Retest 5–6 Years Later in Participants* 25–59 Years Who Never Smoked

	FEV_1	FVC	$FEF_{25-75\%}$	$\dot{V}_{50}$	$\dot{V}_{75}$	$\Delta N_{2750-1250}$
Males						
Lancaster (N = 132)	$-51^{\pm 5}$**	$-57^{\pm 7}$	$-54^{\pm 12}$	$-75^{\pm 21}$	$-44^{\pm 9}$	$-1.9^{\pm 1.2}$
Long Beach (N = 120)	$-66^{\pm 4}$	$-83^{\pm 6}$	$-93^{\pm 10}$	$-121^{\pm 14}$	$-53^{\pm 8}$	$3.2^{\pm 0.9}$
Females						
Lancaster (N = 259)	$-36^{\pm 3}$	$-41^{\pm 4}$	$-56^{\pm 7}$	$-83^{\pm 9}$	$-40^{\pm 7}$	$-1.5^{\pm 0.8}$
Long Beach (N = 188)	$-50^{\pm 3}$	$-61^{\pm 4}$	$-78^{\pm 7}$	$-111^{\pm 8}$	$-40^{\pm 5}$	$6.6^{\pm 1.2}$

*White, non-Spanish-surnamed only, had not changed job or residence because of a respiratory problem. FEV^1 exists at both times.
**Mean of annualized 5-year change; mean = (T2-T1/elasped months × 12 ± standard error).

cance of the differences were higher for most tests for adult women than for men except for the $FEF_{25-75\%}$.

Among non-adults, a significantly less favorable change in the results of the single-breath nitrogen test was observed in the youngest age group (7–10 years) for both males and females in Long Beach. A less favorable change in the results of the single-breath nitrogen test was observed in every age group under 25 years in Long Beach, but was not statistically significant in the 11–14 and 19–24 year groups among males and in the 15–18 year old group in females.

Among non-adult females the changes in spirometry were worse among Long Beach participants in every age group except for the $\dot{V}_{75}$ in the 7–10 year group and reached statistical significance for at least one spirometric test in every age stratum (Table 6C). Among males under 15 years, however, spirometry was not consistently worse in Long Beach participants. Above 15 years spirometry was consistently worse in Long Beach male participants, but did not reach statistical significance in the 15–18 year group. Above 19 years the results were significantly worse in Long Beach participants for all the spirometric indices except $\dot{V}_{75}$.

In every instance in which a statistically significant difference was observed the rate of change was worse among residents of the more polluted area, Long Beach. These included tests believed to reflect both small and large airways function. A significantly greater rate of deterioration was observed at an earlier age among females than among males.

Discussion

Although cohort studies provide the only absolute measures of risk in human populations, a number of problems arise in successfully completing them. Probably the most important is to achieve follow-up of a high proportion of participants. The proportion of all living participants completely retested in this study was low (47 percent and 45 percent in Lancaster and Long Beach, respectively). The major reason for not being retested, however, was not refusal, but migration out of the study area (39 percent and 47 percent, respectively.) The proportion completely retested of those remaining in the study areas was relatively high (75 percent and 77 percent). In the interval between baseline and retesting only a small percentage of participants moved

TABLE 6B—Means of Annual Change in Lung Function Test Results Between Baseline and Retest 5–6 Years Later in Male Participants[*] 7–24 Years Who Never Smoked

Males	FEV_1 (ml)	FVC (ml)	$FEF_{25-75\%}$ (ml/sec)	$\dot{V}_{50}$ (ml/sec)	$\dot{V}_{75}$ (ml/sec)	$\Delta N_{2_{750-1250}}$ (% × 100)
7–10 Years						
Lancaster (N = 96)	$287^{\pm 11\dagger}$	$338^{\pm 14}$	$297^{\pm 18}$	$305^{\pm 19}$	$154^{\pm 14}$	$-6.7^{\pm 1.3}$
Long Beach (N = 32)	$288^{\pm 16}$	$327^{\pm 17}$	$307^{\pm 29}$	$320^{\pm 30}$	$181^{\pm 22}$	$-0.4^{\pm 1.5}$
11–14 Years						
Lancaster (N = 82)	$309^{\pm 11}$	$351^{\pm 14}$	$338^{\pm 19}$	$331^{\pm 21}$	$172^{\pm 18}$	$-1.5^{\pm 1.0}$
Long Beach (N = 14)	$313^{\pm 25}$	$352^{\pm 32}$	$335^{\pm 30}$	$329^{\pm 44}$	$182^{\pm 24}$	$-0.6^{\pm 2.1}$
15–18 Years						
Lancaster (N = 26)	$64^{\pm 17}$	$75^{\pm 17}$	$48^{\pm 30}$	$50^{\pm 36}$	$-15^{\pm 36}$	$-4.0^{\pm 2.4}$
Long Beach (N = 16)	$37^{\pm 14}$	$39^{\pm 18}$	$0^{\pm 23}$	$-10^{\pm 27}$	$-20^{\pm 14}$	$3.2^{\pm 2.1}$
19–24 Years						
Lancaster (N = 21)	$-16^{\pm 13}$	$-12^{\pm 14}$	$-8^{\pm 20}$	$0^{\pm 32}$	$-45^{\pm 21}$	$-1.8^{\pm 2.4}$
Long Beach (N = 23)	$-70^{\pm 13}$	$-72^{\pm 15}$	$-125^{\pm 26}$	$-149^{\pm 40}$	$-90^{\pm 18}$	$0.4^{\pm 0.9}$

[*] White, non-Spanish-surnamed only, had not changed job or residence because of a respiratory problem. FEV_1 exists at both times.
[†] Mean of annualized 5-year change; mean = (T2-T1/elapsed months × 12 standard error).

TABLE 6C—Means of Annual Change in Lung Function Test Results between Baseline and Retest 5–6 Years Later in Female Participants[*] 7–24 Years Who Never Smoked

Females	FEV_1 (ml)	FVC (ml)	$FEF_{25-75\%}$ (ml/sec)	$\dot{V}_{50}$ (ml/sec)	$\dot{V}_{75}$ (ml/sec)	$\Delta N_{2_{750-1250}}$ (% × 100)
7–10 Years						
Lancaster (N = 68)	$236^{\pm 7\dagger}$	$261^{\pm 9}$	$269^{\pm 16}$	$258^{\pm 19}$	$125^{\pm 13}$	$-7.9^{\pm 1.7}$
Long Beach (N = 29)	$209^{\pm 10}$	$216^{\pm 15}$	$258^{\pm 27}$	$232^{\pm 25}$	$146^{\pm 22}$	$+3.7^{\pm 1.8}$
11–14 Years						
Lancaster (N = 85)	$124^{\pm 9}$	$120^{\pm 11}$	$147^{\pm 17}$	$118^{\pm 19}$	$98^{\pm 13}$	$-1.7^{\pm 1.2}$
Long Beach (N = 24)	$68^{\pm 16}$	$75^{\pm 22}$	$62^{\pm 25}$	$41^{\pm 23}$	$6^{\pm 25}$	$+5.5^{\pm 2.0}$
15–18 Years						
Lancaster (N = 49)	$11^{\pm 7}$	$23^{\pm 10}$	$-26^{\pm 18}$	$-28^{\pm 20}$	$-48^{\pm 18}$	$-0.4^{\pm 1.5}$
Long Beach (N = 16)	$-20^{\pm 9}$	$-16^{\pm 10}$	$-80^{\pm 21}$	$-82^{\pm 21}$	$-66^{\pm 17}$	$+4.4^{\pm 2.0}$
19–24 Years						
Lancaster (N = 27)	$-6^{\pm 10}$	$-11^{\pm 13}$	$-30^{\pm 20}$	$-20^{\pm 25}$	$-53^{\pm 17}$	$-2.9^{\pm 2.1}$
Long Beach (N = 36)	$-18^{\pm 13}$	$-18^{\pm 17}$	$-60^{\pm 15}$	$-77^{\pm 16}$	$-64^{\pm 14}$	$+2.9^{\pm 1.2}$

[*] White, non-Spanish-surnamed only, had not changed job or residence because of a respiratory problem. FEV_1 exists at both times.
[†] Mean of annualized 5-year change; mean = (T2-T1/elapsed months × 12 ± standard error).

because of respiratory problems (2.1 percent in Long Beach and 0.5 percent in Lancaster).

A major way of assessing the impact of a lower-than-desired response rate is to determine the differences in the baseline test results between participants who were retested and those who were not. The difference in the mean test indices at baseline were not significantly different in those who were not retested than in those who subsequently completed lung function retesting, suggesting that those who were not retested were substantially similar in respiratory function to those who were.

A particular problem for cohort studies of the relationship of air pollution to changes in lung function test results is the possible impact of air pollution levels on the day of testing.[8] For that reason, analysis was carried out comparing the results of lung function testing with levels of each of the major pollutants on the day of testing. No significant correlations with test results were seen and no consistent pattern emerged for the major pollutants occurring at higher concentrations in Long Beach, suggesting that the range of levels of these pollutants prevailing during the testing periods had relatively little impact on the results of the lung function testing in this study.

The tests used in this study can be affected by a number of confounding factors including instrument characteristics, subject effort, and technician performance.[29] Thus, there is continual concern with the accuracy and reliability of the equipment and testing procedures, particularly in a mobile laboratory in which movement of the equipment from site to site can precipitate instrument drift. For that reason, the test-retest difference in FEV_1 observed in the five to six year interval in the Mobile Lung Function Laboratory was compared with results obtained on a 3 percent subsample of participants tested on both occasions at the UCLA Reference Laboratory. This comparison revealed only a small difference between the two laboratories in favor of showing a slightly greater deficit in FEV_1 in Long Beach if, in fact, the difference in deficit was also present in the entire group tested.

For the lung function tests, the mean of the absolute change in individual test results was used rather than differences in predicted values. Thus, differences between communities in age and height could have biased the results. The mean height was, however, similar in the two

TABLE 7—Magnitude of t* and Significance Levels for Differences in Rate of Change of Lung Function Test Results in Lancaster and Long Beach Participants with $p < .05$

Sex/Age (years)		FEV_1	FVC	$FEF_{25-75\%}$	$\dot{V}_{50}$	$\dot{V}_{75}$	$\Delta N_{2_{750-1250}}$
Males							
7–10	T=	—	—	—	—	—	−3.12
	P<	—	—	—	—	—	.002
11–14	T=	—	—	—	—	—	—
	P<	—	—	—	—	—	—
15–18	T=	—	—	—	—	—	−2.25
	P<	—	—	—	—	—	.03
19–24	T=	2.90	2.93	3.89	3.11	—	—
	P<	.006	.005	3×10^{-4}	.003	—	—
25–59	T=	2.15	2.74	2.55	1.97	—	−3.64
	P<	.032	.006	.011	.049	—	3×10^{-4}
Females							
7–10	T=	2.16	2.63	—	—	—	−4.85
	P<	.033	.001	—	—	—	1×10^{-8}
11–14	T=	2.87	—	2.52	2.04	3.33	−3.13
	P<	.005	—	.013	.044	.002	.002
15–18	T=	2.24	—	2.18	—	—	—
	P<	.023	—	0.33	—	—	—
19–24	T=	—	—	—	1.99	—	−2.66
	P<	—	—	—	.051	—	.01
25–59	T=	3.48	3.49	2.20	2.37	—	−6.20
	P<	5×10^{-4}	5×10^{-4}	.028	.018	—	1.6×10^{-9}

$$*t = \frac{\overline{X}_1 - \overline{X}_2}{S} \text{ where } S = \frac{S_1^2(N_1-1)+S_2^2(N_2-1)}{N_1+N_2-2}\left(\frac{1}{N_1}+\frac{1}{N_2}\right)$$

areas. The mean ages of the two populations were similar although the females in Long Beach were on average three years older than females in Lancaster, whereas the males in Long Beach were on average one year younger than in Lancaster. A prior study of this population suggested that the rate of decline in FEV_1 remained fairly constant over the age range 25–59 years.[33]

Recent reports have suggested that young individuals living in homes supplied with gas, especially for cooking, may have more respiratory problems than persons in homes that are supplied with electricity.[34–38] The percentage of homes that used gas for heating, however, was exactly the same in both communities (94 percent).

Many people in Southern California commute long distances to workplaces in which they may experience air pollution patterns different from those at their place of residence. Individuals in Long Beach commuted to areas of lower levels of the major pollutants (except for oxidants), whereas most residents of Lancaster who commuted did so to areas of higher levels of pollution.[28] This pattern would tend to minimize the actual difference in pollutant exposures for participants in the two study areas and, thus, would reduce the likelihood of observing a pollution effect on lung function test results.

A number of other factors that could have biased the results have been dealt with by restricting the population analyzed in this paper. Differences in racial distribution were reduced by including only White non-Spanish-surnamed participants in the analyses and by excluding individuals who reported a history of changing residence or occupation because of a respiratory problem at baseline. The number of individuals who had worked in an occupation that might be associated with respiratory injury was too high to permit excluding them from analysis. Their occupations were not concentrated in any one or two types of exposure and the duration of their employment in any type was generally less than five years. The proportion with such a history, however, was higher in Lancaster than in Long Beach and, thus, including them in the analysis probably reduced the likelihood of observing less favorable changes in Long Beach.

The average annual change in FEV_1 among these never-smoking adults was higher than has been reported in most previous population studies.[6–8,39–41] The levels observed in our study are comparable with some of the more recent reports of changes in lung function over time in occupational groups.[42–44] Although we looked intensively for methodologic problems that may have caused these large rates of decline in adults, we were unable to identify any consistent factors that would account for the magnitude of decline observed in FEV_1. One possibility is that these large average annual declines in FEV_1 may reflect the accumulated respiratory effects of chronic exposure to air pollution. Supporting this hypothesis is the previous observation that the annual rate of decline in FEV_1 between 25 and 59 years of age in these populations increased only very slightly with age[33] in contrast to the significant increase in the annual rate of decline with aging reported in other publications.[45,46] Because of local migration patterns, fewer of our older participants and more of our younger participants were raised in the Los Angeles area. This, and the consistently poorer (more positive) changes in $\Delta N_{2_{750-1250}}$, even in the youngest participants in Long Beach, suggest that the younger members of our cohorts raised in Los Angeles may experience greater drops in their lung function test parameters when they reach later life than the drop currently observed in the older members of our cohorts who were raised in less polluted areas. If in fact this hypothesis is true, it is cause for concern.

The test demonstrating differences most frequently and with the highest levels of significance was the $\Delta N_{2_{750-1250}}$. Furthermore, in the youngest age groups this test often demonstrated the only significantly worse deterioration, suggesting that physiologic changes may be occurring in children that are not as readily identified by the presumably less sensitive spirometric tests until adulthood. Since the $\Delta N_{2_{750-1250}}$ is thought to reflect function primarily in the small airways, the results of this cohort study suggest that this may be the site of earliest injury due to exposure to the type of air pollutants found in the Long Beach area. Buist and colleagues[47] and McCarthy, *et al*,[48] have demonstrated that the single-breath nitrogen test is more sensitive than spirometry in detecting early functional abnormality involving the small airways. In cross-sectional studies we were not able to observe differences between communities in this parameter.[27,28,30] We had previously observed, however, that the $\Delta N_{2_{750-1250}}$ is subject to considerable variability which may account for the difficulty in identifying significant differences in cross-sectional studies.[49] Inter-subject variability may be a greater problem in cross-sectional studies than intra-subject variability in cohort studies in which differences in two measurements from the same individual are being considered.

Among adults who never smoked, rate of decline in all of the tests noted in Table 7 was significantly worse in residents of Long Beach except for the $\dot{V}_{75}$ in which a directionally similar difference did not attain statistical significance.

Although the large differences in the results of $\Delta N_{2_{750-1250}}$ in children in even the youngest age groups suggest that the small airways are the earliest site of pathology resulting from chronic exposure to the mix of air pollutants occurring in Long Beach, the greater deterioration in the spirometric indices indicates that by the time residents of the area reach adulthood, the adverse changes in the small airways have progressed and/or the large airways have become affected as well. It remains to be determined if the adverse changes in the lungs resulting from chronic exposure to this mix of pollutants causes sufficient respiratory impairment over a lifetime to reduce their ability to function satisfactorily or only reduces their considerable reserve capacity without causing clinically significant functional impairment.

Ware, *et al*, have studied the respiratory symptom and lung function effects of chronic exposure to TSP, SO_2, and TSO_4 at two different examinations one year apart in children 6–10 years of age in six cities in the United States and have found no relationship between respiratory parameters and levels of these pollutants.[50] While it is tempting to compare the results of that study to the present study there are several problems with doing so. First, the measures of air pollutants were different. Whereas Ware, *et al*, used the mean of the 24-hour values, we used the means of the daily peak hourly values for SO_2, although for TSP and TSO_4 we used the 24-hour totals. Of greater importance is the fact that we looked at the mean annual change in lung function values within each individual over a five to six year interval whereas Ware, *et al*, looked at the correlations of the pollutant values with FEV_1 and FVC at two time periods only one year apart. Thus, their study design was essentially two consecutive cross-sectional correlations to mean lung function values for groups of children in each area whereas we looked at the mean of change within each individual over a five-year period. Nonetheless, there are some similarities between the studies. Neither found consistent correlations between respiratory symptoms and levels of air pollutants. Further, we did not observe a significant correlation between change in lung function and pollutant level in males 7–10 years of age. The correlation we observed in both males and females 7–10 years was in the single-breath nitrogen test, a possibly more sensitive measure of early decrement in lung function. It will be interesting to observe whether Ware, *et al*, find correlations between pollutant levels and lung function with additional follow-up of the children in these six cities. We did not consistently observe significant differences in FEV_1 and FVC in boys until 15–18 years. We did, however, observe consistent difference in earlier age groups using the single-breath nitrogen test.

We previously observed a greater deficit in several lung function test parameters between Lancaster and an area subject to very high levels of oxidants, Glendora.[26,30] The greatest difference in pollutant exposures between Long Beach and Glendora was in the levels of oxidants (much higher in Glendora), nitrogen dioxide (higher in Long Beach), and SO_2 (higher in Long Beach). Mean levels of SO_4 were similar in these two communities and higher than in Lancaster which had primarily oxidant exposure, which, although high, was half that in Glendora. In the Long Beach comparison, the measures incorporating the large airways (FEV_1, FVC) were consistently significantly different in adults whereas only the FEV_1 in adult females in the Glendora comparison were significant. On the other hand, a significant difference in $\dot{V}_{75}$ was observed only for Glendora. The deterioration in the single-breath nitrogen test in Glendora was significantly worse in every age-sex group under 25 years compared whereas they were significantly worse only in males 7–10 years and 15–18 years and in females 7–14 and 19–24 years in Long Beach. Significant differences in most of the spirometric indices in these younger age groups were not consistently identified in either polluted community compared to Lancaster. It is possible that the type of pollutants that were present in greatest concentrations in Long Beach (NO_2, hydrocarbons, and SO_2) were more likely to cause damage in the large airways whereas oxidants were more likely to cause damage in the smaller airways as reflected by the greater magnitude of differences for the $\Delta N_{2_{750-1250}}$ and $\dot{V}_{75}$ in Glendora. Further, exposure to oxidant pollutants may cause measurable damage earlier (according to the single-breath nitrogen test) than SO_2 and NO_2. These interpretations are consistent with results of controlled exposure studies in experimental animals which demonstrate that characteristic ozone-induced lesions occur in the lung periphery (centiacinar region)[51,52] while chronic exposure to SO_2 produces clinical, physiologic, and histologic changes of chronic bronchitis with greater involvement of proximal than distal airways.[53]

Given the nature of epidemiological studies which must deal with populations as they actually exist in the community rather than with laboratory animals which can be kept under experimental conditions, these inferences should be investigated further. It appears, however, that chronic exposure to either mix of pollutants results in less rapid growth of lung function in children and a greater rate of deterioration in adulthood.

These observations have serious implications for safeguarding the health of the public and controlling levels of pollutants in urban areas in the United States. These studies need to be verified by others, but the implications for health should not be ignored by legislators and government administrators. Given the difficulties of carrying out epidemiologic studies of cohorts of individuals over long periods of time the probability of being able to observe statistically significant differences is smaller than for similarly designed studies done under laboratory conditions. For this reason, the burden of proof should now be to prove that high levels of these pollutants do not affect lung function and, therefore, until that is demonstrated efforts should be increased to improve the quality of air in the urban areas of the United States. ☐

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APPENDIX A

Single-breath Nitrogen Test

Ventilation distribution was determined using an Ohio-Series 700 nitrogen analyzer, Electro-Medical (Ohio Medical Products, Houston) model 780 spirometer, electronics module, sample-head assembly, remote vacuum pump assembly, and Hewlett-Packard X-Y recorder (Hewlett-Packard, San Diego) with time base.

Subjects performed these tests in the standing position with a nose clamp and flanged rubber mouthpiece in place. After a few normal tidal breaths and stabilization of the system, the subject was asked to exhale completely and to hold his breath briefly at the residual volume position. The valve was switched to the reservoir containing 100 percent oxygen and the expiratory port simultaneously opened to the (electronic) spirometer. The subject was asked to inhale fully and deeply, within less than 4 seconds, to total lung capacity, then to exhale slowly and completely at a constant flow rate maintained between 0.5 and 0.8l/s according to an X-Y tracing which was visible to him. Residual volume was reached over no longer than 10 s. The expired volume and expired nitrogen concentrations were simultaneously recorded on the horizontal and vertical axes of the X-Y recorder. A minimum of three trials was completed for each resident.

Each tracing was read by only one individual, the Chief Technologist, who assigned values for the percentage of nitrogen (percent N_2) in the expired air at 750 and 1,250 ml of expirate and identified both the point at which the inflection between phase III and Phase IV occurred and the point at which total volume was exhaled (residual volume).

A Measles Outbreak at a College with a Prematriculation Immunization Requirement

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ABSTRACT

Background. In early 1988 an outbreak of 84 measles cases occurred at a college in Colorado in which over 98 percent of students had documentation of adequate measles immunity (physician diagnosed measles, receipt of live measles vaccine on or after the first birthday, or serologic evidence of immunity) due to an immunization requirement in effect since 1986.

Methods. To examine potential risk factors for measles vaccine failure, we conducted a retrospective cohort study among students living in campus dormitories using student health service vaccination records.

Results. Overall, 70 (83 percent) cases had been vaccinated at ≥12 months of age. Students living in campus dormitories were at increased risk for measles compared to students living off-campus (RR = 3.0, 95% CI = 2.0, 4.7). Students vaccinated at 12–14 months of age were at increased risk compared to those vaccinated at ≥15 months (RR = 3.1, 95% CI = 1.7, 5.7). Time since vaccination was not a risk factor for vaccine failure. Measles vaccine effectiveness was calculated to be 94% (95% CI = 86, 98) for vaccination at ≥15 months.

Conclusions. As in secondary schools, measles outbreaks can occur among highly vaccinated college populations. Implementation of recent recommendations to require two doses of measles vaccine for college entrants should help reduce measles outbreaks in college populations. (*Am J Public Health* 1991;81:360–364)

Introduction

Since licensure of live measles vaccine in the United States in 1963, there has been a marked reduction of reported measles incidence. In 1978, the United States began an effort to eliminate indigenous measles. The elimination strategy called for achieving and maintaining high immunization levels, careful surveillance, and aggressive outbreak control. The high immunization levels were to be achieved using a single dose of measles vaccine.[1]

Although there has been a 98 to 99 percent reduction in the number of annual reported cases from the pre-vaccine era, measles outbreaks still occur. Two predominant patterns of measles transmission have been observed: outbreaks occurring in predominately unvaccinated inner-city preschool-age children, and outbreaks occurring in highly vaccinated secondary school and college populations.[2,3] While most outbreaks occur in secondary schools, cases from college campuses have accounted for between 1.5 percent and 19.8 percent of cases each year from 1980 to 1989 (Table 1).[4,5] In 1983, the record low year for reported measles cases, campus outbreaks and non-campus cases associated with these outbreaks accounted for 32.4 percent of total cases.[6]

There are several reasons why measles outbreaks may be likely to occur in colleges and universities. Some college-aged students may not have been vaccinated in the early years following licensure of measles vaccine; others may not have been appropriately vaccinated at school entry or thereafter. Data from serological surveys suggest that between 5 and 15 percent of college-aged individuals may be susceptible to measles.[7] The propensity for college students to congregate in large groups and their travel to areas where measles transmission is endemic may increase the potential for introduction and spread of measles virus on college campuses.

School immunization laws have been demonstrated to be an effective means of assuring high measles vaccination levels and preventing measles outbreaks among kindergarten through 12th grade children and adolescents.[8] The American College Health Association[9–11] and the Immunization Practices Advisory Committee of the US Public Health Service (ACIP)[12] have recommended that colleges and universities require students to present evidence of measles immunity as a condition for enrollment. In early 1988, a measles outbreak occurred at a college that had implemented such an immunization requirement. This outbreak provided an opportunity to investigate the occurrence of measles in a highly vaccinated college population and to examine potential risk factors for measles vaccine failure.

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TABLE 1—Reported Measles Cases on US College Campuses, 1980–89

Year	Total US Cases	Campus Cases		No. of Colleges Reporting Cases
		No.	%	
1980	13,506	200	(1.5)	36
1981	3,124	101	(3.2)	19
1982	1,714	115	(6.7)	14
1983	1,497	296	(19.8)	19
1984	2,587	67	(2.6)	17
1985	2,822	354	(12.6)	26
1986	6,282	174	(2.8)	21
1987	3,655	141	(3.9)	22
1988	3,396	267	(7.9)	20
1989	18,193	1,643	(9.0)	93

Background

Fort Lewis College is a public four-year college in Durango, Colorado. There were 3,555 students registered at the time of the outbreak. Since September 1986, the college has required students to provide proof of immunity to measles, as well as to other vaccine-preventable diseases, before enrolling. Adequate measles immunity was considered documentation of physician-diagnosed measles, receipt of live measles vaccine on or after the first birthday, or serologic evidence of immunity. Prior to this outbreak almost 99 percent of the student population were in compliance with this requirement and had documentation on file at the student health center.

Methods

Case Definition and Case Ascertainment

A case of measles was defined as an illness that met the Centers for Disease Control clinical case definition[13] (generalized maculopapular rash ≥3 days duration, fever ≥101 F, if measured, and at least one of the following: cough, coryza, or conjunctivitis). A suspected case was any rash illness with fever; a confirmed case met the clinical case definition and was either serologically confirmed or epidemiologically linked to another confirmed or clinical case of measles. A case was considered to be serologically confirmed if there was a fourfold rise in titer between acute and convalescent specimens by the complement-fixation assay.

Students were informed about the outbreak by class announcements, articles in the student newspaper, and reports on the campus radio station. They were instructed to report to the student health service at the onset of any febrile or rash illness. A disease control specialist from the Colorado Department of Health investigated every suspected case.

Outbreak Control

On January 8, 1988, after the third clinical case of measles was reported at the college, a manual review of college immunization records was conducted. A total of 40 students were found without documentation of measles immunity. All but three of these students were promptly vaccinated. The students not vaccinated had medical exemptions to vaccination and were excluded from campus for the duration of the outbreak. On January 12, 1988, the Colorado Department of Health placed the campus under public health orders. All indoor sporting events and other indoor college activities on or away from campus were restricted to participants who could show proof of measles immunity. All Fort Lewis participants in intercollegiate activities were examined prior to an event for signs and symptoms of measles prodrome. Furthermore, no spectators were allowed to attend these events. In order to prevent further measles transmission, all suspected measles cases among Fort Lewis College students were isolated in special dormitory rooms located near the student health service.

Retrospective Cohort Study

To investigate risk factors for measles vaccine failure, we conducted a retrospective cohort study among all students living in campus dormitories. Vaccination histories were obtained from student health center vaccination records. Student variables collected include: name, sex, race, class, date of birth, and housing status. Students who had received measles vaccine less than 14 days prior to rash onset were considered to be unvaccinated. We investigated the following potential risk factors for vaccine failure: number of doses of measles vaccine received, age at vaccination, and time since vaccination. Since several investigations of recent measles outbreaks have found individuals vaccinated before 1980 to be at higher risk for measles than those vaccinated in 1980 or after,[14] we also evaluated year of vaccination.

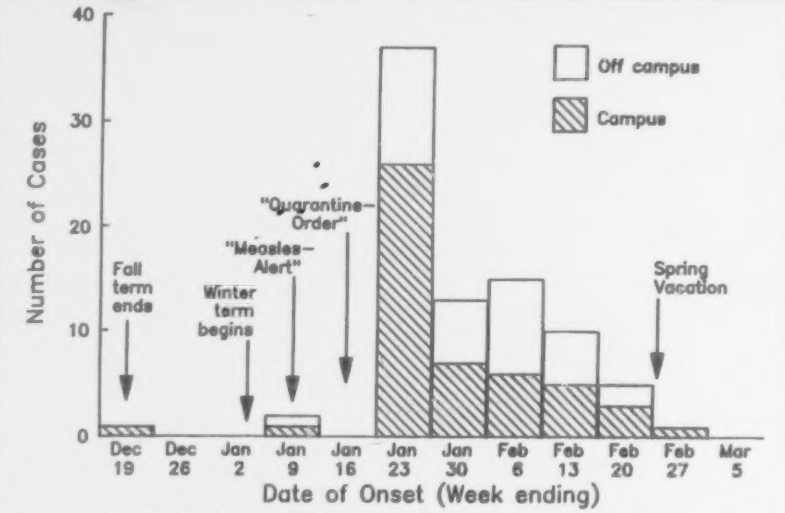
Age at vaccination was defined as the number of months between the date of birth and the most recent vaccination date on the vaccination record. Time since vaccination was calculated as the number of years between the date of most recent vaccination and the beginning of the outbreak (January 1, 1988). The age-at-vaccination analysis was limited to single dose vaccinees who were vaccinated before 1980; the time-since-vaccination and year-of-vaccination analyses were limited to single dose vaccinees who were vaccinated at 15 months of age or older. Finally, in order to verify information contained in case vaccination records, efforts were made to contact health care providers who had administered the vaccine. A physician-verified vaccination record was defined as confirmation of at least month and year of vaccination.

Differences in attack rates among groups in the retrospective cohort study were measured using the chi-square and Fisher's exact tests. Measles vaccine effectiveness and 95 percent confidence intervals were calculated using the method described by Orenstein, et al.[15]

Results

Between December 15, 1987, and March 10, 1988, a total of 84 measles cases in five generations of measles transmission occurred among Fort Lewis College students (Figure 1). All cases satisfied the clinical case definition for measles. Of the total cases, 11 (13 percent) were serologically confirmed.

The index case was an 18-year-old female freshman from South Carolina who had been vaccinated against measles at 14 months of age. The source of her infection is unknown. Measles transmission from the index case to second generation campus cases occurred at the Durango airport. Further measles transmission occurred primarily in campus dining halls, in classrooms, and at several campus social events. There was no spread of measles to other schools despite 10 inter-collegiate indoor activities or games, and only five cases were reported among non-college



Source: Colorado Department of Health

FIGURE 1—Reported Measles Cases by Week of Rash Onset, Fort Lewis College, December 1987–March 1988.

residents of Durango. Two of the noncollege cases were directly linked to the index case.

Of the 84 cases, 70 (83 percent) occurred in individuals with evidence of measles vaccination at 12 months of age or older, including 20 (24 percent) vaccinated at 12 to 14 months of age. Of the 70 cases, vaccination histories (89 percent) were verified by the physician who had administered the vaccine. Five cases (6 percent) occurred in persons vaccinated before the first birthday, and 9 cases (11 percent) occurred in persons without documentation of measles vaccination. Of the cases in students without documentation of measles vaccination, vaccine was not routinely recommended for four (two born before 1957, two with a history of physician-diagnosed measles), and a fifth student had a religious exemption to vaccination.

Forty-six cases (55 percent) were freshmen, 46 (55 percent) were males, and 53 (63 percent) occurred in students living in campus dormitories. Seventy-five (89 percent) cases were White, seven (8 percent) were Native American, one case (1 percent) was Black, and one (1 percent) was Hispanic. Cases ranged in age from 17–32 years; 62 (74 percent) occurred in persons 18–20 years of age.

The overall attack rate among Fort Lewis College students was 2.4 percent. There were no differences in attack rates by race. Attack rates by housing status, sex, and class are summarized in Table 2. Students living in campus dormitories were at higher risk for measles than students living off-campus. When the analysis was limited to students living in campus dormitories, differences in attack rates by class are no longer observed.

In the retrospective cohort study among students living in campus dormitories, students without documentation of measles vaccination and those vaccinated before 12 months of age were at greater risk for measles than students vaccinated at 12 months of age or older (Table 3). No case of measles occurred in 46 students who had received two doses of measles vaccine after 12 months of age. Students vaccinated once at less than 12 months or at 12 to 14 months of age were at greater risk for measles than those vaccinated once at 15 months of age or greater. Although students vaccinated prior to 15 months of age were at increased risk for measles, these cases accounted for only 30 percent of the total cases. Students vaccinated before 1980 were not at significantly increased risk for measles compared with those vaccinated in 1980 or after. No trend for increasing attack rate with increasing time since vaccination was observed among students vaccinated once at 15 months of age or older (Figure 2).

The estimates of vaccine effectiveness among students living in campus dormitories was 80 percent (95 percent CI = 51–92 percent) for vaccination at 12 to 14 months of age and 94 percent (95 percent CI = 86–98 percent) for vaccination at 15 months or greater.

Discussion

The Fort Lewis College measles outbreak occurred in spite of virtually complete implementation of a prematriculation measles vaccination requirement. It was thus similar to outbreaks that have occurred in recent years among highly vaccinated junior and senior high school populations.[16–21] While the prematriculation requirement may have prevented a larger outbreak, it is apparent that measles outbreaks, such as the one described, can occur in highly vaccinated populations.

In this outbreak, living in campus dormitories was found to be a risk factor for acquiring measles. The relatively crowded living conditions and high contact rate among students in a college dormitory can facilitate measles virus transmission from infected to susceptible individuals.

Consistent with other investigations,[22] vaccination before the age of 15 months was found to be a risk factor for measles vaccine failure. The increased relative risk observed in persons vaccinated before 15 months of age has been attributed to the persistence of maternal antibody in infants, which interferes with live measles vaccine. Although age of vaccination was found to be a risk factor, 60 percent of cases occurred in students vaccinated at 15 months or older. As in other investigations,[17,19,21,23,24] there was no evidence in this outbreak that the risk for measles increases with time since vaccination.

We did not find evidence that vaccination prior to 1980 was a risk factor for measles in this outbreak. Other investigations, however, have found this to be a risk factor for measles vaccine failure.[14] Prior to the addition of an improved heat stabilizer to measles vaccine in 1979, individuals may have received a less effective vaccine, causing lower rates of seroconversion and an increased risk for measles. Alternatively, one may speculate that the finding of a lower risk for measles in individuals vaccinated since 1980 may be due to the possibility that some of these persons may have, in fact, been receiving a second dose of measles vaccine. Students may often find it easier to receive a second dose of measles vaccine than to obtain documentation of their initial measles vaccination.

The investigation of this outbreak found measles vaccine to be over 90 percent effective for vaccination at 15 months or greater. Other investigations have found similar results.[25] The occurrence of

TABLE 2—Risk Factors for Measles, Attack Rates by Student Characteristics, Fort Lewis College

Characteristic	Students	Cases	Attack Rate	Relative Risk	95% CI
Housing					
Dormitories	1,278	53	4.1%	3.0	(2.0–4.7)
Off-campus	2,277	31	1.4%	1.0	referent
Sex					
Male	1,922	46	2.4%	1.0	(0.7–1.6)
Female	1,633	38	2.3%	1.0	referent
Class					
Freshman	1,347	46	3.4%	4.3	(1.9–10.1)
Sophomore	842	19	2.3%	2.9	(1.2–7.2)
Junior	603	13	2.1%	2.7	(1.1–7.2)
Senior	763	6	0.8%	1.0	referent
Class*					
Freshman	759	34	4.5%	2.5	(0.3–17.7)
Sophomore	352	13	3.7%	2.0	(0.3–15.2)
Junior	112	5	4.5%	2.5	(0.3–20.5)
Senior	55	1	1.8%	1.0	referent

*Among students living in campus dormitories.

measles outbreaks in populations with high immunization levels suggests that the estimated 5 to 10 percent vaccine failure rate may still provide enough susceptibles to allow sustained transmission of a virus as communicable as measles in some settings, such as a college dormitory.

The two national advisory bodies for immunization policy, the Committee on Infectious Diseases of the American Academy of Pediatrics (Red Book Committee) and the ACIP, have recently considered the problem of measles outbreaks in highly vaccinated populations and have recommended the institution of a routine two-dose measles vaccination schedule.[26,27] Furthermore, both committees recommend that college students have, at the time of college entry, documentation of having received two doses of measles vaccine after the first birthday. The American College Health Association has endorsed this recommendation.[28] Prematriculation immunization requirements provide a mechanism for colleges and universities to ensure that students are in compliance with this new recommendation.

Whether a second dose of measles vaccine will significantly increase population measles immunity and decrease the risk of measles outbreaks is not conclusively known. However, this investigation and several others have found lower risks for measles in persons who received two doses of vaccine.[17,19,21,23] The power of these studies to detect statistically significant differences, however, was low due to the relatively small number of multiple dose vaccinees. Experience from the military suggests that a second dose of measles vaccine should be effective in preventing outbreaks.[29]

Measles elimination has proved more difficult than previously predicted.[30] A single dose strategy, while highly effective, has not been able to totally prevent measles outbreaks. The full implementation of a routine two-dose measles vaccination schedule, however, should help reduce measles outbreaks in highly vaccinated populations. ☐

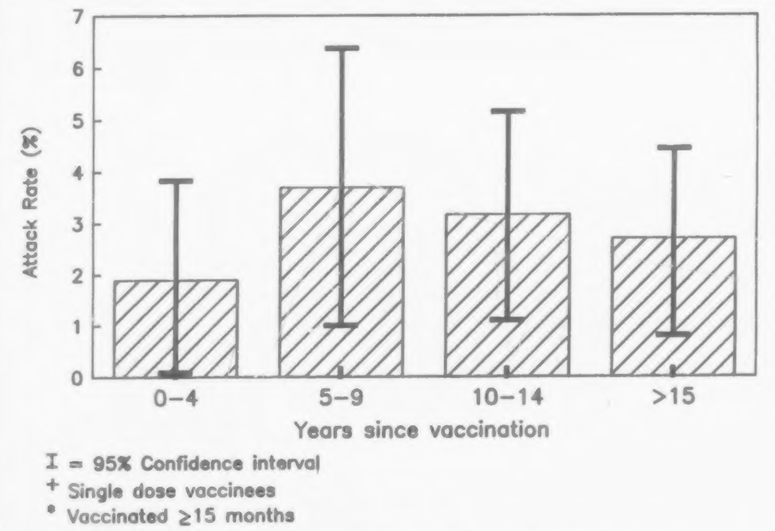


FIGURE 2—Attack Rate by Time Since Vaccination, Fort Lewis College.†*

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TABLE 3—Risk Factors for Measles for Students Living in Campus Dormitories, Fort Lewis College

Characteristic	Students	Cases	Attack Rate	Relative Risk	95% CI
Doses					
0 doses	6	3	50.0%	13.1	(5.6–30.8)
1 dose (<12 mos)	52	5	9.6%	2.5	(1.1–6.1)
1 dose (≥12 mos)	1,156	44	3.8%	1.0	referent
2 doses (1 dose <12 mos and 1 dose ≥12 mos)	18	1	5.6%	1.5	(0.2–10.0)
2 doses (both doses ≥12 mos)	46	0	0.0%	0.0	(0.0–1.7)
Age at vaccination[a][b]					
<12 mos	52	5	9.6%	3.0	(1.2–7.7)
12–14 mos	164	16	9.8%	3.1	(1.7–5.7)
≥15 mos	695	22	3.2%	1.0	referent
Year of vaccination[a][c]					
<1980	695	22	3.2%	1.6	(0.6–3.8)
≥1980	297	6	2.0%	1.0	referent

[a] Single dose vaccinees
[b] Vaccinated before 1980
[c] Vaccinated ≥ 15 months

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Assessment of Drug Abuser Treatment Needs in Rhode Island

William E. McAuliffe, PhD, Paul Breer, PhD, Nancy White Ahmadifar, PhD, and Cathie Spino, DSc

ABSTRACT

Background. Rhode Island's Division of Substance Abuse asked us to assess the State's drug treatment needs and make recommendations regarding its treatment system for the next three years.

Methods. We used a statewide telephone drug use survey of 5,176 households supplemented by drug-related hospital discharges, Division of Drug Control statistics, and interviews with providers, state officials, and out-of-state experts. Drug abuse was measured with items from the Diagnostic Interview Schedule. Abusers were asked if they were receiving or wanted to receive treatment.

Results. Survey responses, used to estimate the unmet need for drug treatment, indicated a need to triple drug treatment services. Regression models using survey data indicated that the treatment network was overly centralized in the Providence area. Interviews with state officials, clinicians, and out-of-state experts provided material for recommendations on reimbursement policy, treatment mix, quality assurance, and cost containment.

Conclusions. The RI Department of Health's certificate-of-need program adopted our overall recommendation for tripling the drug treatment system as its guideline in evaluating proposals for new treatment facilities. With State funding of a new adolescent center and expansion of outpatient slots in the private sector, this recommendation has now been fully implemented. (*Am J Public Health* 1991;81:365–371)

Introduction

Recent federal and foundation initiatives on drugs and acquired immunodeficiency syndrome (AIDS) among intravenous (IV) users have led many states and communities to assess their needs for drug treatment services. Up to now, attempts to determine drug abuse treatment needs have lacked adequate tools. In the 1970s when substantial public funds for drug treatment first became available, planners based their needs assessments on census data, arrests, treatment admissions, and occupancy rates.[1,2] At best, however, such statistics represent only indirect approximations of addict prevalence and may be influenced by actions of the agencies that report the data.[3] For example, if services are too expensive, not well located, or not well matched to addict clinical or cultural needs, underutilization of treatment facilities may occur even when there is substantial unmet need for services in a state. The present study sought to develop improved methodologies.

In 1986, the Rhode Island Division of Substance Abuse (DSA) sought documentation of unmet need for drug abuse services to convince legislators of the necessity for third-party reimbursement of drug abuse treatment and to establish guidelines for regulators evaluating proposed treatment facilities. DSA had previously contracted with Brown University for a needs assessment of the combined alcohol and drug treatment system.[4] Although the Brown Report estimated drug use prevalence in Rhode Island from age- and gender-specific *national* rates reported in a 1982 survey of drug use by the National Institute on Drug Abuse (NIDA), the Report's authors recommended that a local drug abuse prevalence survey be conducted.

Several developments in the last two decades have made improved needs assessments possible for state and local agencies. In 1972, the federal government demonstrated the feasibility of household surveys of nonmedical drug use employing face-to-face interviews with a cross-section of the nation's population.[5] Some states (e.g., New York and New Jersey) have now initiated periodic household surveys of their own.

In 1981 and 1986, the New York State Division of Substance Abuse Services conducted a statewide survey of drug use by telephone interview.[6] A pilot study (1980) found that random digit dialing and a sample drawn from local telephone directories both returned response rates similar to those of a previous face-to-face survey of drug use (66 percent to 72 percent). Drug use rates in the statewide telephone survey were similar to those found in the 1979 NIDA face-to-face household survey, thereby confirming experiments which had found no significant difference between telephone and face-to-face responses to a variety of interview questions (see Discussion). Compared to personal interviews, telephone interviews represent an attractive approach for localities with limited budgets since telephone in-

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terviews cost an average of half as much as face-to-face surveys using identical questions.[7]

Measures of drug *use*, however, have limited value in estimating the number of persons in the population who need treatment. Effective planning requires a measure of clinical levels of drug *abuse*. In 1981, Robins and her colleagues developed the Diagnostic Interview Schedule (DIS)[8] for epidemiological studies of mental disorders including alcohol and drug abuse. The DIS combines answers to questions on the frequency and consequences of use to form reliable scales of abuse and dependence that satisfy the American Psychiatric Association's formal (DSM-III) criteria for drug abuse and dependence.[9] Studies have demonstrated that the DIS can be used successfully in face-to-face household interviews,[10] and its use permits comparison with other populations already reported in the literature.[11] When DIS scores were compared with clinical diagnoses based on patient charts and DSM-III checklists, results showed moderate agreement (kappas for individual symptom scales ranged from −.01 to .63 with an average of .22 in one study[12] and .30 in another[13]).

Methods

The primary source of drug abuse data for this study was a telephone survey of Rhode Island households. The survey employed a proportional, stratified, multistage sample of persons age 12 or over living in households with telephones. The telephone numbers were identified by random digit dialing. A random sample of telephone numbers was drawn from each of the state's eight drug treatment catchment areas, with each area represented by a total proportionate to its share of the state population. Assuming a response rate similar to those found in previous New York State drug surveys (66 percent to 72 percent), we planned to use 7,000 of these numbers to reach the goal of 5,000 interviews. Interviewers asked to speak to the person in the household (12 years or older) with the most recent birthday; no substitutions were permitted.

The sample statistics were weighted[14] to produce representative parameter estimates for catchment areas and the state as a whole. Each respondent received an initial weight equal to the total number of persons age 12 or over in the household; the number of respondents in each catchment area was also weighted by the actual population size of the area. The weights were adjusted to correct for differences in response rate among catchment areas and multiplied by a constant to make the weighted sample size equal to the unweighted sample size of 5,176 completed interviews.

To increase community acceptance of the survey, all treatment and prevention agencies were notified about it and the Governor mentioned the study in his State of the State address. Several articles appeared in Rhode Island newspapers urging community cooperation.

We used the 1986 New York State drug survey[6] for basic drug use items and the Diagnostic Interview Schedule[8] for measures of abuse and dependence. We designed questions to measure *interest* in obtaining treatment. The final instrument was translated into Spanish for Spanish-speaking respondents.

Interviewers called each number in the sample until they succeeded in interviewing the designated respondent; determined that the number was either a business phone, had been disconnected or never assigned to a household by the telephone company; or reached the cut-off point of seven attempts. Interviewers made their first few calls in the evening (5:00 to 9:00); if these were not successful, they made further attempts on weekends. As a last resort, they tried calling on weekday mornings and afternoons. When a respondent refused to be interviewed, the survey supervisor arranged to have a more experienced interviewer try again several weeks later.

Reliability and Validity Studies

For 100 consecutive interviews conducted by several different interviewers, we compared the answers recorded by a supervisor listening on a remote monitor with the answers recorded by the interviewers. To estimate the potential bias of respondents who refused to cooperate, we compared the responses of persons (N = 130) who initially refused to respond but agreed to be interviewed when called again, to the responses of individuals who never refused. To estimate the potential bias of households that failed to answer the telephone, our research staff called all numbers not reached after seven attempts by the subcontractor. We then compared the responses of hard-to-reach individuals (the 92 reached by our staff) to those of respondents who were reached with seven or fewer calls. We also compared the sample demographics with census data.

To evaluate the truthfulness of respondents, we conducted a "randomized response" experiment in which a randomly selected subsample of respondents (N = 167) flipped three coins to determine whether or not to answer questions on drug use truthfully.[15] Since these respondents tossed the coins at home, interviewers could not tell whether the respondents were answering truthfully or just obeying the dictates of the toss ("yes" if all heads, "no" if all tails). Aggregate responses were statistically adjusted for expected frequencies. We then compared the resulting frequency of drug use reported by experimental subjects with the frequency of drug use reported by respondents in the general survey.

Drug Use and Abuse Measures

We estimated the percentage of lifetime and current moderate users, potential abusers and abusers. *Potential abusers* were respondents who reported "pathological" drug use (i.e. use of a drug daily for two weeks or more without a prescription) *or* that they had tried to cut down and failed to do so. *Abusers* were those who admitted to *both* pathological use *and* significant social impairment as a result of that use *or* to being drug dependent (showed signs of withdrawal and tolerance) whether or not they met the other two criteria.[8]

Computation of Unmet Demand

We defined the effective demand for drug treatment services as the number of services likely to be requested at current prices, assuming widespread knowledge of the availability of services and reasonable accessibility to them. We divided effective demand into *met demand* (the aggregate of clients enrolled in a drug treatment program at some time during the last twelve months) and *unmet demand* (the number of abusers who had not been in treatment during that period but who represented suitable candidates for admission). We asked all respondents who qualified as abusers by DIS criteria whether they were in treatment and, if not, whether they wanted treatment or at least had ever thought about entering treatment.

A conventional approach to estimating effective demand involves multiplying the estimated number of abusers in a population by a fixed percentage of abusers thought likely to seek treatment, the rule of thumb being 15 percent to 20 percent.[4] Using estimates of drug abuse prevalence from the telephone survey, we also estimated demand for treatment using this fixed percentage method.

TABLE 1—Validity Studies on Subpopulations

% Ever Used	Converted Refusals (n = 130)	Never Refused (n = 5046)	Difference (95% CI)	Hard to Reach (n = 92)	Not Hard To Reach (n = 5084)	Difference (95% CI)	Randomized Response* (n = 167)	Main Survey (n = 5176)	Difference (95% CI)
Marijuana	10.7	24.4	−13.7 (−19.2,−8.2)	29.7	24.0	5.7 (−3.7,+15.1)	28.0	24.1	3.9 (−3.0,+10.8)
Cocaine	3.0	7.3	−4.3 (−7.3,−1.3)	8.6	7.1	1.5 (−4.3,+7.3)	8.5	7.2	1.3 (−3.0,+5.6)
LSD/PCP	3.0	3.7	−0.7 (−3.7,+2.3)	3.0	3.7	−0.7 (−4.2,+2.8)	3.3	3.7	−0.4 (−3.2,+2.4)
Heroin	0.0	0.5	−0.5 (−0.7,−0.3)	0.0	0.5	−0.5 (−0.7,−0.3)	−7.5	0.5	

*Frequencies have been statistically adjusted for forced choice. The negative frequency for heroin use suggests that some respondents in the experiment could not bring themselves to say "yes" to having used heroin, even when the coin toss dictated that answer. The percent saying "yes" (6.9) was less than expected on the basis of chance alone. Subtracting the actual percent from the expected percent produced a negative number. Without additional data, that negative frequency is uninterpretable. Because the other three drugs showed no significant difference, it seems reasonable to conclude that the same was true for heroin.

Community Indicators of Drug Abuse

We analyzed established drug abuse indicators[16–18] to validate the telephone survey findings and to estimate optimal geographic distribution of services. Indicators were drug treatment admissions, hospital discharges (primary or secondary diagnoses of drug overdose, and so on), from the Rhode Island Department of Health, drug-related criminal complaints (suspected use, possession, or sales) from the Rhode Island Division of Drug Control, and drug arrests from the Federal Bureau of Investigation.

Allocating New Slots

We were asked to estimate the number of new treatment slots needed (if any), and to recommend how those slots should be distributed across both treatment modalities and catchment areas. To do so, we first looked at the drug use patterns of those respondents who said they wanted treatment now. Opiate users (who might be appropriate for methadone maintenance) were separated from users of other drugs. We then considered the current mix of treatment modalities in Rhode Island and used interviews with providers and state officials to identify gaps in modalities and levels of patient care. We also weighed the relative cost-effectiveness of different treatments. We estimated the optimal geographic distribution of admissions from their regression on survey drug abuse rates, criminal complaints, and hospital discharges.

Interviews with Providers and State Officials

A staff sociologist interviewed 38 drug program directors and state officials regarding current programs and problems involving client access, availability of services, AIDS, special needs, and other issues encountered in day-to-day operations, such as financing mechanisms, regulatory functions, relationships among agencies, and the continuum of care. To broaden our understanding of policy alternatives, we interviewed professionals from 13 states outside of Rhode Island.

The total cost (including indirect expenses) of the needs assessment was $150,000, of which our subcontractor received $50,000 ($10 per completed interview). The entire study (including a final report) took exactly six months to complete.

Results

Validity of Survey Findings

Of the 7,364 eligible households in the sample, 5,176 (70.3 percent) completed the interview. In the 100 consecutive cases where a supervisor coded responses independently of the interviewer, 99.3 percent of the responses were coded identically. Since most of the inconsistencies involved a question about friends' behavior, we excluded that item from further analysis.

Fifteen percent of those who initially refused to be interviewed eventually agreed to participate in the study. These 130 "converted refusals" reported *lower* frequencies of drug use and abuse than did those respondents who never refused (Table 1). The differences, however, were small except for ever-use of marijuana.

A comparison of 92 hard-to-reach respondents with those that were reached without extra effort revealed no significant differences in either drug use or abuse (Table 1).

The 167 respondents who were given the opportunity to disguise their answers in the "randomized response" experiment were no more likely to report illicit drug use than those in the general survey who were asked the same questions directly (Table 1).

A comparison of the survey sample with 1980 census figures for Rhode Island indicates close agreement on age, gender, and ethnicity.[19] A regression of catchment area drug abuse prevalence rates (measured by the survey) on drug-related hospital discharges and drug complaints provides further evidence ($R^2 = .89$) of the validity of the survey results.

Extent of Drug Use

Our survey yielded an estimated total of 13,948 current abusers, less than 2 percent of the state's 12 or older population of 793,334 (Table 2); 8,430 residents qualified as current potential abusers and 60,388 additional residents qualified as current minimal-to-moderate users. Approximately one-fourth of Rhode Island residents age 12 or older admitted to having *ever* used at least one illicit drug (marijuana, cocaine, LSD, or heroin) or licit psychoactive drug (sedative, amphetamine, or prescribed pain killer) without a prescription. The figure for *current* use (at least once in the past year) was 10.4 percent. Marijuana was used and abused more than any other drug, followed by cocaine, opiates, sedatives, amphetamines, and hallucinogens in that order.

Unmet Demand for Treatment

To determine unmet demand for treatment, we divided abusers not in treatment into a matrix of five levels of interest in treatment by three levels of the currency of abuse (Table 3). Analysis of the matrix generated 5,365 abusers (rows 1 and 2, and "recent" and "present abusers" in row 3) that made up the unmet demand for drug abuse treatment. We assumed that "past abusers" and "recent abusers" in row 1 were using currently

TABLE 2—Estimated Current Users, Potential Abusers, and Abusers, by Type of Drug

In Last Year	At Least One	Marijuana	Cocaine	Opiates**	Sedatives*	Amphetamines*	LSD/PCP
Users (Minimal or Moderate)	60,388	49,813	18,239	10,116	6,591	5,364	3,525
Potential Abusers	8,430	7,664	1,839	153	153	1,073	0
Abusers	13,948	10,269	4,292	1,839	2,605	1,839	766
Total	82,766	67,746	24,370	12,108	9,349	8,276	4,291
(% of R.I. pop.)	(10.4)	(8.5)	(3.1)	(1.5)	(1.1)	(1.0)	(0.5)

*Used on own (i.e., without prescription).
**Includes heroin, and pain killers used without a prescription.

TABLE 3—Levels of Unmet Demand for Treatment

Level	Definition	Past Abusers[a] (33,414)	Recent Abusers[b] (6,284)	Present Abusers[c] (7,089)
1	Want Treatment? Yes	307	920	920
2	Want Treatment? Not sure	460	0	460
3	Ex-clients[d]	2,146	1,073	1,225
4	Thought about Treatment[e]	1,686	460	460
5	Never Thought about Treatment[f]	28,815	3,831	4,024

[a] Have abused in past but not in last year.
[b] Have abused in past year but not in last month.
[c] Have abused in last month.
[d] Former drug clients who said "no" to wanting treatment now.
[e] Said "no" to wanting treatment now, have never been in treatment, but have considered treatment in past.
[f] Said "no" to wanting treatment now, have never been in treatment, and have never considered treatment.

but not at the point of abuse, or were in early recovery. The "not sures" in row 2 were included on the assumption that they would decide to enter a program if openings at the most sought-after services (methadone maintenance and short-term residential programs) were not in such short supply. Despite not wanting treatment now, the "present abusers" in row 3 were included because they had sought treatment before, had relapsed, but, we believed, would want treatment again were it readily available. The "recent abusers" in row 3 would similarly want intermediate care or aftercare. We excluded the respondents in row 3 who had not abused for over a year on the assumption that they were sufficiently recovered.

To get the total demand for treatment, we added unmet demand and met demand. Rather than estimating met demand from the number of survey respondents *currently* in treatment (which would exclude individuals discharged earlier in the year), we used actual MIS admissions (2,212) for the previous year. In this way, we estimated total effective demand to be 7,577 in 1986. We recommended that Rhode Island should expand its treatment system until it could accommodate all 7,577.

According to the traditional rule of thumb for estimating the number of addicts who will avail themselves of treatment at any one time, there were 2,789 Rhode Island residents (20 percent of the estimated 13,948 current drug abusers in the State) who were candidates for drug abuse treatment at the time of our study. This estimate suggests that if Rhode Island were to provide treatment for all addicts who wanted it, it would have to expand its services by 26 percent (from 2,212 to 2,789) as opposed to the 243 percent expansion (2,212 to 7,577) indicated by the first method.

Expansion of Services

Given the State's fiscal constraints and siting difficulties for new facilities, we recommended that the expansion of services be divided into two phases. In phase I (two to three years) the State would add enough slots to accommodate the estimated 2,150 abusers who said in the telephone interview that they wanted treatment right now (all abusers from row 1). Adding 2,150 admissions would nearly double the present treatment system. In phase II, which would extend for several years beyond phase I, the State would add enough slots to accommodate the remaining 3,200 abusers (all abusers from row 2 and most from row 3) whom we deemed likely applicants for new treatment slots but whose desire to enter a program immediately was less definite under present conditions. A phased expansion would allow for adjustments if drug abuse indicators suggested substantial changes in addict prevalence during phase I or if our conclusions about demand for services were not borne out by experience.

For most treatment modalities, we recommended making phase I increases proportionate to the number of slots already in existence. We assumed that the mean number of admissions per slot would remain constant in the future and that the current mix of services reasonably reflected the demand for different types of services. We suggested a somewhat larger expansion for methadone maintenance programs, however, because half of the abusers who said they wanted treatment reported heroin addiction, and because, at the time of the study, there was a two-year waiting period at the State's only methadone center. We also recommended adding a small number of residential 28-day drug treatment slots and a still smaller number of outpatient narcotic antagonist (Naltrexone) slots[20,21] to serve the opiate addicts. Neither of these latter two modalities formally existed in Rhode Island at the time of the study.

To guide geographic distribution of new treatment slots, we regressed treatment admissions on a weighted index of drug-related hospital discharges, drug-related complaints to the Division of Drug Control, and our survey results on the number of drug abusers in each catchment area. For outpatient drug-free admissions (including day treatment), the regression of treatment capacity on the weighted index of hospital discharges, drug complaints, and abusers revealed in the survey yielded an R^2 of .55. The results (Figure 1) confirmed the opinion expressed by some officials that treatment facilities were overly concentrated in central regions of the state. We recommended that proportionately more new admissions should be added according to the discrepancy between actual and expected number of slots.

To determine where new methadone slots should be sited, we performed a similar regression analysis and comparison using opiate admissions as the dependent variable and opiate use as reported in the survey as the independent variable. In the case of short-term (28 day) and long-term (therapeutic community) residential modalities where the number of existing slots was too small and concentrated for a regression analysis, we adopted the rule of thumb that the State should locate new slots in areas that presently had no residential facilities for drug abusers. This made sense in light of the survey finding that there were significant numbers of drug abusers in every catchment area.

Interview Results

Providers and state officials were in agreement that the primary problem was the inadequacy of treatment capacity. While providers stressed shortage of staff and low salaries, state officials stressed the need for mandation of third-party reimbursement of substance abuse services, quality assurance, and greater access to treatment for subpopulations such as adolescents and the poor. We used these interview results in recommending increased funding and new mechanisms for improving utilization of existing funds (revision of traditional lengths of stay and establishment of a statewide panel to review treatment practices). Interviews with policymakers in other states provided us with valuable information on some of the problems to be expected with third-party mandation such as changes in the number of drug abusers seeking care and increases in premium cost. We also recommended for-profit programs and "medical maintenance"[22] for increasing methadone slots in the face of limited public allocations.

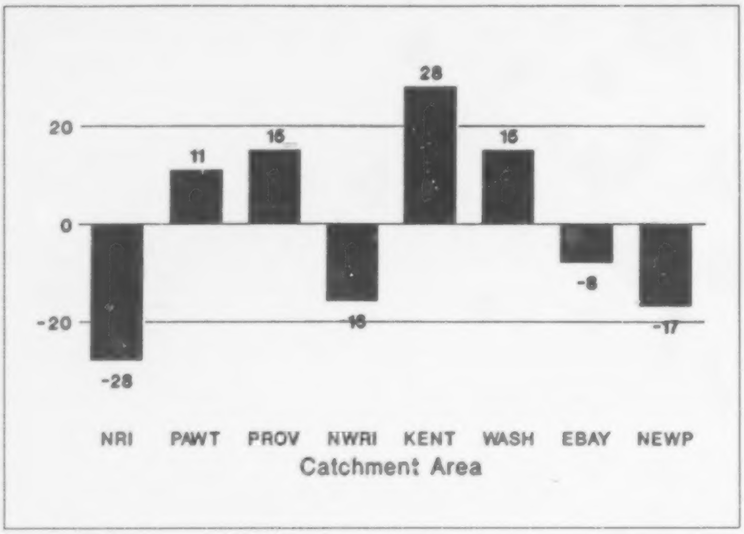

FIGURE 1—Adequacy of treatment allocation: Actual minus expected number of OPDF slots,* by catchment area.

*Estimated by statistically regressing OPDF slots on an index made up of: 1) current abuse rate of *any* drug; 2) number of drug-related hospital discharges; and 3) number of complaints reported to the RI Division of Drug Control (OPDF Slots = .67 + .07 (Drug Problem Index).

Reaction to Recommendations

The initial reaction to our report was mixed. In a series of hearings and written statements, most state officials praised it.[19] Third-party payors supported the report's recommendations for reduced lengths of stay and a higher ratio of outpatient to inpatient treatment, while objecting to its endorsement of mandatory drug treatment benefits (several months before we submitted our final report, the Rhode Island legislature had mandated third-party coverage for drug abuse treatment). Providers were "particularly impressed with the depth of the household survey and the methodology used to determine effective demand for treatment,"[19] but felt that we had paid too much attention to cost containment and quality regulation.

The Division of Substance Abuse, its parent organization, the Department of Mental Health, Retardation and Hospitals, and the Department of Health endorsed our recommendation that the drug treatment system be doubled in the next few years. In the year following submission of our report (1988), the State provided $700,000 for new methadone maintenance slots and another $3,900,000 for the construction and operation of a 60-bed adolescent treatment facility which our report had recommended. Private agencies added 300 methadone slots, 600 outpatient drug-free slots, and 60 28-day residential treatment slots. With the exception of the $700,000 for methadone maintenance and the projected adolescent facility, all of the expansion was funded by the private sector. By July 1989, the State's drug treatment network had expanded to levels close to those recommended for phase I of the expansion.[23] Methadone slots had reached 75 percent of the phase I target with a concomitant decrease in waiting lists. Outpatient drug-free slots had exceeded the phase I target and were already approaching the level we had recommended for phase II. The number of inpatient 28-day slots had already surpassed the phase II target.

The only major drug treatment modality to lag behind in the expansion was long-term residential care (therapeutic communities), the primary form of treatment excluded from the 1987 bill making third-party insurance coverage of drug abuse treatment mandatory throughout Rhode Island. In our follow-up report integrating findings from the Brown (alcohol) and Harvard (drugs) reports, we made a special plea for legislation to correct this omission.*

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*McAuliffe WE, Lewis D, Breer P, Williams C: *Rhode Island integrated alcohol and drug treatment program matrix.* Cranston, Rhode Island: Division of Substance Abuse, Rhode Island Department of Mental Health, Retardation and Hospitals, unpublished report.

Throughout the expansion of the treatment network, the State exerted a continuing influence through its control over the certificate of need (CON) process. Once the Department of Health and related departments approved our recommendations, the State Health Planning Committee formally adopted the report's treatment slot recommendations as a guide in evaluating applications for new treatment facilities (both private and state funded).

Discussion

The percent (25) of Rhode Island residents age 12 or older who reported using illegal drugs at some point in their lives agrees with the results of national studies[24,25] and studies of nearby states.[6] Estimating the effective demand for drug treatment from survey results produced a figure almost three times as large as the total estimated by the fixed percentage method which assumes that only 20 percent of all abusers will seek treatment, the major difference stemming from our discovery of past abusers who want treatment and former clients who are currently abusing. The validity of the larger estimate is supported by the fact that Rhode Island doubled its treatment slots in the two years following submission of our report[23] and has thus far reported no difficulty filling those new slots.

The validity of estimating drug use and abuse by interview surveys has been studied since the 1960s. Measures of drug-use frequency have shown high internal and test-retest consistency among both addicts and non-addicts.[26,27] Surveys of special populations (addicts in treatment,[26,28–32] psychoactive prescription drug users,[33] Vietnam military returnees,[34] and addicts once known to the police[35]) have successfully corroborated interview statements of drug use with official records, family members, treatment personnel, and urinalysis results. Arrestees awaiting trial[36] are one group known to underreport substantially their use of illicit drugs.

There is both direct and indirect evidence that drug use survey responses in general populations are also reasonably valid.[37] The most direct evidence comes from use of the "randomized response" technique.[38] Respondents who are given a chance to conceal their true answers from the interviewer have generally reported levels of drug use equal to or only slightly higher than those of respondents asked to state their answers openly.[15,39] Indirect evidence can be found in the similarity of drug-use rates reported by different investigators studying independent but demographically comparable segments of the population.[37] Further support for the validity of drug-use questionnaires comes from the finding that, when respondents are asked about fictitious drugs, only a small fraction report any use.[40–42]

Studies comparing telephone survey responses with those of face-to-face interviews have generally found the results to be similar.[43,44] A recent study[45] found, however, that compared to face-to-face interviewing, telephone interviewing yielded significantly lower estimates of marijuana use among Blacks. The differential persisted after controlling for demographic differences between the two samples and excluding non-telephone households, suggesting that it had something to do with the mode of interviewing itself. However, the difference in rates did not hold for Whites, nor did it hold for cocaine use among either Blacks or Whites. Other controlled drugs were not tested. If there is a biasing effect in telephone interviewing, it is very limited and unlikely to affect overall prevalence rates of drug use and abuse in general surveys, particularly in surveys of states like Rhode Island with small minority populations.

Thus, research on drug surveys in general and telephone interviewing in particular suggests that under ordinary circumstances respondents tell the truth about their drug use. Where systematic bias occurs, it is typically in the direction of underreporting the frequency of drug use.[37,42] It follows that a treatment needs assessment based on community prevalence estimates of drug use and abuse tells us the *minimum* number of slots needed if the community is to make treatment available to all who need and would seek it. As for our own survey, several indicators discussed earlier suggested that the findings have acceptable reliability and validity.

One of the drawbacks of the household survey is that it yields proportionately few individuals who qualify as drug abusers. In our sample, less than two percent met criteria for drug abuse, and less than three-tenths of 1 percent expressed interest in getting treatment. To enlarge the base of abusers in order to investigate detailed planning issues, we suggest employing a larger total sample or, where cost considerations rule that option out, oversampling geographic areas known by arrests and hospital data to contain many drug addicts.

A drawback specific to the telephone drug abuse survey is that it excludes a subpopulation (households without a telephone) likely to have a high prevalence of drug abuse. This population, however, is quite small. In 1981, 98 percent of Rhode Island households had telephones.[46] Intravenous drug users (IVDUs) are a subgroup of drug abusers that one might expect to have the lowest telephone rates of all. In nearby Massachusetts, unpublished data from our current multi-city study of IVDUs (N = 577) not in treatment who were recruited through street outreach, indicates that 84 percent either have their own phone (38 percent) or have access to a phone at their current residence (46 percent).

Another limitation of any household survey, whether telephone or face-to-face, is that it excludes both the homeless and the institutionalized (prisoners, psychiatric patients, college dorm residents). The prevalence of drug abuse is known to be higher in these populations than in the general household population.[47] New York State's Division of Substance Abuse has recently developed a strategy for surveying the homeless, utilizing prearranged telephone interviews with randomly chosen residents of urban shelters.[47] In many states, drug treatment services for prisoners and psychiatric patients are provided by agencies other than the drug treatment agency and therefore may not be included in a needs assessment.

A recent US Senate report recommended improving upon survey estimates of cocaine abuse prevalence by adding nonsurvey data on nonhousehold populations (arrestees, drug patients, and the homeless).[48] Although we believe that the report's methodology may over-correct survey estimates, the report actually estimated *fewer* cocaine addicts in Rhode Island (3,900) than we estimated from our telephone survey (4,300).[19]

The orderly expansion of treatment services in Rhode Island testifies to the effectiveness of the needs estimation methods used in the present study. With improvements in survey methodology, statistical techniques, and the development of standardized diagnostic instruments suitable for testing large populations, substance abuse planning technology has entered a new era. It is reasonable to expect further progress in years to come. ☐

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Racial/Ethnic Differences in Smoking, Drinking, and Illicit Drug Use among American High School Seniors, 1976–89

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ABSTRACT

Background. This paper reports racial/ethnic differences in the use of licit and illicit drugs by high school seniors in the United States.

Methods. The study uses questionnaire data from annual, nationally representative surveys of seniors from 1976 through 1989. Combined sample sizes were 57,620 for 1976–79; 75,772 for 1980–84; and 73,527 for 1985–89.

Results. Native Americans had the highest prevalence rates for cigarettes, alcohol, and most illicit drugs; White students had the next highest rates for most drugs. Asian Americans had the lowest prevalence rates, and Black students had levels nearly as low except for marijuana. Prevalence rates for the Hispanic groups were mostly in the intermediate ranges except for relatively high cocaine use among the males. Trend patterns for most forms of drug use were similar across subgroups, although cigarette use declined more sharply for Black than White seniors, resulting in greater Black-White differences in recent years.

Conclusions. This study, other school-based studies, and general population surveys all show relatively low levels of drug use by most non-White youth, especially Black Americans and Asian Americans. Multivariate analyses indicate that such subgroup differences in high school seniors' drug use are not primarily attributable to family composition, parents' education, region, or urban-rural distinctions. (*Am J Public Health* 1991;81:372–377)

Introduction

Drug use among American youth continues to be a focus of attention for politicians, educators, the media, and the general public. Although the media frequently focus on large cities, the nation's drug problems are not limited to any one group or to any one geographic area. The impacts of drug use and abuse are felt more keenly in the Black, Hispanic, and Native American communities,[1] but the patterns of drug use by members of these groups, particularly adolescents, are not well documented. The purposes of the present report are: to document the extent to which drug use varies among racial/ethnic subgroups of high school seniors; to explore whether subgroup differences have been changing in recent years; and to consider some of the implications of such differences.

The data reported here are based on samples of high school seniors, representative of the United States as a whole. The study does not undertake to explore substantial differences in drug use which may exist from one city to another, or from one neighborhood to another. More importantly, surveys of high school seniors do not include those youth who drop out before graduation; thus, although this report represents most young people, including the majority of those in each racial/ethnic subgroup studied, it does not cover the total cohort of 17- to 18-year-olds. These limitations are treated at some length in the discussion.

Methods

The Monitoring the Future project, conducted by the University of Michigan's Institute for Social Research under grants from the National Institute on Drug Abuse, has surveyed large, nationally representative samples of high school seniors during the spring of each year since 1975. The design and procedures are summarized briefly below; detailed descriptions are presented elsewhere.[2–4] The measures of drug use and racial/ethnic identification are presented in the Appendix.

Samples

A three-stage sampling procedure is employed,[5] with stage 1 the selection of particular geographic areas, stage 2 the selection of one or more high schools in each area, and stage 3 the selection of seniors within each high school. The result each year is an area probability sample of the 48 coterminous states. About 130 high schools participate each year (approximately 118 public and 12 private). About 83 percent of the sampled seniors generally participate (nearly all nonparticipation results from absenteeism), yielding samples of about 17,000 seniors each year.

Survey Procedures

Data are collected via questionnaires administered in classrooms by locally based Institute for Social Research representatives and their assistants, following carefully standardized procedures. The questionnaires are designed for optical scanning; all items are closed-ended. Five different questionnaire forms have been

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TABLE 1—Racial/Ethnic Distribution of the Monitoring the Future Combined Samples*

	1976–79		1980–84		1985–89	
	N	%	N	%	N	%
White	48993	85.0	62157	82.0	57864	78.7
Black	5965	10.4	8958	11.8	8187	11.1
Mexican American	1088	1.9	1480	2.0	3117	4.2
Puerto Rican/Latin American	572	1.0	1105	1.5	1392	1.9
Asian American	439	0.7	1139	1.5	1899	2.6
Native American	563	1.0	933	1.2	1068	1.5
Total	57620	100.0	75772	100.0	73527	100.0

*The multistage sampling design with respondents clustered in schools produces larger sampling errors than would a simple random sample of equivalent size. For statistics in the present paper, the estimated design effects are 8.0 for White males and females, 3.0 for Black males and females, and 2.2 for the males and females in any of the other groups. Frequencies used to calculate statistical significance are equal to the actual number of cases shown in the table divided by the appropriate design effect (i.e., 8.0, 3.0, or 2.2). When referring to group differences the term "significant" or "significantly" refers to $p < .01$.

used each year, with each administered to a random one-fifth of the sample.

Statistical Significance and Confidence Intervals

Confidence intervals vary greatly depending upon sample size, design effects (see note to Table 1), and percentage size. As examples and general guidelines, we note the following: The *largest* 95% confidence intervals around percentages in Tables 2–4 are 1.7 percent for Whites, 2.8 for Blacks, 3.7 for Mexican Americans, and 6.3 for Native Americans (the smallest subgroup). Any Black-White difference equal to or exceeding 3.0 percent is significant at the 95% confidence level. It would be unnecessarily cumbersome to specify significance levels for every subgroup comparison discussed herein; instead, we have adopted the convention of describing *as differences* only those which exceed the 99% confidence level.

Results

Our primary emphasis is upon racial/ethnic subgroup differences in drug use, especially those which have been somewhat consistent across time. We examined annual data from the senior classes of 1976 through 1989, combining the classes into three groups: 1976–79, 1980–84, and 1985–89. The resulting numbers of cases for the total samples and the racial/ethnic subgroups are displayed in Table 1.

Table 1 indicates that the proportions of Whites in the samples decreased over time, whereas the proportions of Asian Americans and Hispanics increased substantially. These changes generally parallel shifts in the overall population of youth, although it should be kept in mind that the proportions in our samples reflect some substantial subgroup differences in high school dropout rates, as well as other differences (including a somewhat higher rate of missing data for several of the subgroups other than White). In particular, it should be noted that nationwide dropout rates for Blacks have declined in recent years, and are now only slightly higher than those for Whites.[6]

Subgroup Differences in Prevalence of Drug Use

Marijuana

Annual prevalence rates for marijuana (1985–89 combined; see Table 2) are highest among Native American females and males, and nearly as high among White males and females, and Mexican American males; rates are somewhat lower for Mexican American females, Puerto Rican and other Latin American males, and Black males; and rates are lowest among Puerto Rican and other Latin American females, Black females, and Asian American males and females. Monthly and daily (or nearly daily) prevalence rates for marijuana show similar subgroup distinctions, except that male-female differences are more pronounced (Tables 3 and 4).

Cocaine

Prevalence rates for cocaine are highest for Native Americans (males and females) and males in both Hispanic groups, but significantly lower for Hispanic fe-

TABLE 2—Annual Prevalence of 13 Types of Drugs, 1985–89 Data Combined, by Sex and Race

	Percent who used in last 12 months											
Types of Drugs	White Male	Black Male	MexAm Male	PR&LA Male	Asian Male	Nat Am Male	White Female	Black Female	MexAm Female	PR&LA Female	Asian Female	Nat Am Female
Minimum N =	(28056)	(3688)	(1518)	(680)	(982)	(537)	(29808)	(4499)	(1599)	(712)	(917)	(531)
Marijuana/Hashish	40.2	29.8	37.3	30.6	19.6	42.0	36.0	18.4	26.0	21.3	17.1	44.0
Inhalants[a]	8.8	2.6	6.0	5.1	4.8	9.6	5.2	2.2	4.3	2.9	3.2	4.4
Hallucinogens	8.3	1.9	5.9	6.5	3.0	10.0	5.0	0.6	2.2	2.1	2.2	9.0
LSD	7.0	1.3	5.2	3.4	2.5	7.8	3.9	0.3	1.6	1.1	1.9	7.2
Cocaine	11.9	6.1	14.7	15.6	5.8	14.2	9.3	2.6	7.6	8.2	5.7	15.5
Heroin	0.7	0.7	0.9	1.2	0.4	1.5	0.3	0.4	0.4	0.4	0.2	1.0
Other opiates[b]	6.5	1.9	3.2	3.0	3.1	7.4	5.3	1.2	2.1	1.6	2.1	5.7
Stimulants[b]	13.6	4.6	11.3	8.0	5.6	17.0	14.7	3.1	10.1	5.9	7.0	19.4
Sedatives[b]	5.3	2.2	4.7	4.6	3.4	8.8	4.4	1.2	2.7	2.6	2.6	6.4
Barbiturates[b]	4.4	1.9	4.1	4.0	2.6	7.2	3.8	1.1	2.4	2.5	2.3	6.2
Methaqualone[b]	2.5	0.9	1.2	2.3	1.5	4.8	1.4	0.3	0.5	0.5	0.9	2.2
Tranquilizers[b]	5.8	1.7	2.6	3.1	3.2	6.9	5.9	1.4	2.1	4.1	1.8	8.7
Alcohol	88.3	72.5	82.4	80.6	69.3	82.0	88.6	63.9	73.6	77.2	67.5	81.3

[a] Data based on four questionnaire forms. N is four-fifths of N indicated.

[b] Only drug use which was not under a doctor's orders is included here.

TABLE 3—Thirty-Day Prevalence of 14 Types of Drugs, 1985–1989 Data Combined, by Sex and Race

	Percent who used in last 30 days											
Types of Drugs	White Male	Black Male	MexAm Male	PR&LA Male	Asian Male	Nat Am Male	White Female	Black Female	MexAm Female	PR&LA Female	Asian Female	Nat Am Female
Minimum N =	(28056)	(3688)	(1518)	(680)	(982)	(537)	(29808)	(4499)	(1599)	(712)	(917)	(531)
Marijuana/Hashish	25.0	18.5	22.0	18.9	9.7	27.6	19.8	9.9	13.6	9.6	8.1	23.9
Inhalants[a]	3.4	1.4	2.3	2.0	1.3	5.2	2.0	1.4	2.1	0.8	0.8	0.9
Hallucinogens	3.5	0.9	2.4	3.0	1.5	3.6	1.7	0.3	0.7	0.4	0.3	2.7
LSD	2.8	0.6	1.9	1.6	1.1	3.1	1.1	0.2	0.3	0.2	0.1	2.2
Cocaine	5.6	2.6	8.2	8.1	1.8	7.3	4.1	1.3	3.0	2.9	2.6	9.2
Heroin	0.3	0.5	0.3	0.9	0.1	1.1	0.1	0.3	0.2	0.2	0.0	0.4
Other opiates[b]	2.3	0.9	1.1	1.5	1.6	4.0	1.9	0.6	0.7	0.5	0.7	2.4
Stimulants[b]	5.6	1.9	4.9	3.1	2.1	8.1	6.0	1.3	4.8	1.2	3.6	10.3
Sedatives[b]	2.2	1.1	2.0	1.8	1.9	4.8	1.7	0.5	0.9	1.3	1.3	2.6
Barbiturates[b]	1.8	0.9	1.7	1.3	1.4	3.7	1.5	0.5	0.8	1.2	1.0	2.1
Methaqualone[b]	0.9	0.5	0.6	0.9	0.8	2.5	0.5	0.1	0.2	0.1	0.6	0.9
Tranquilizers[b]	1.9	0.8	0.8	0.6	1.7	3.1	2.0	0.5	0.9	1.5	0.9	2.2
Alcohol	72.3	49.2	65.0	55.4	43.7	69.0	66.6	32.8	50.5	43.0	34.2	60.2
Cigarettes	29.8	15.6	23.8	22.0	16.8	36.8	34.0	13.3	18.7	24.7	14.3	43.6

[a] Data based on four questionnaire forms. N is four-fifths of N indicated.
[b] Only drug use which was not under a doctor's orders is included here.

TABLE 4—Daily Use of Three Types of Drugs in the Last 30 Days, 1985–1989 Data Combined, by Sex and Race

	Percent who used daily in last 30 days											
Types of Drugs	White Male	Black Male	MexAm Male	PR&LA Male	Asian Male	Nat Am Male	White Female	Black Female	MexAm Female	PR&LA Female	Asian Female	Nat Am Female
Minimum N =	(28056)	(3688)	(1518)	(680)	(982)	(537)	(29808)	(4499)	(1599)	(712)	(917)	(531)
Marijuana/Hashish	5.1	2.6	4.2	3.5	1.7	8.2	2.1	0.9	1.1	0.5	0.5	4.3
Alcohol												
Daily	7.0	4.2	8.3	4.0	2.3	10.1	2.8	0.7	2.6	0.9	0.9	5.4
5+ drinks in a row/last 2 weeks	48.1	24.0	45.3	31.4	19.4	48.1	31.3	9.3	23.6	14.5	10.7	33.7
Cigarettes	18.8	8.6	11.6	13.3	9.0	26.0	22.5	7.1	8.1	13.3	9.4	33.8
Half-pack or more per day	12.5	3.3	5.2	6.1	4.4	18.4	13.3	2.2	2.5	4.2	4.5	23.4

males; rates for Whites are fairly similar to those for Hispanics, except that the difference is somewhat smaller between males and females; and rates are significantly lower for Blacks and Asian Americans. In the case of Asian Americans, prevalence rates for males and females are essentially the same; however, for Blacks, like Hispanics, the prevalence is about twice as high for males as for females.

Other Illicit Drugs

Tables 2 and 3 provide details on a number of other illicit drugs: inhalants, hallucinogens, heroin, other opiates, stimulants, sedatives, and tranquilizers (any use under doctor's orders is excluded). For most drugs and most subgroups, fewer females than males report use, with usage rates being highest for Native American seniors, and lowest for Black and Asian American seniors. Differences among White and Hispanic seniors are generally smaller and not consistent across these other illicit drugs.

Alcohol

Alcohol use among White and Native American males and females is relatively high, while among Black and Asian American seniors, only about half of the males and one-third of the females report use of alcohol during the past month. Substantial subgroup differences exist in frequent or heavy use of alcohol (i.e., five or more drinks in a single sitting). As shown in Table 4, almost half of White, Native American, and Mexican American males report such heavy alcohol use once or more during the two weeks preceding the survey. Heavy drinking is significantly less prevalent among Puerto Rican and other Latin American males, and even lower among Black males and Asian American males. Racial/ethnic differences among females generally parallel those for males, but at distinctly lower prevalence levels. Although relatively few seniors drink alcohol on a daily or near daily basis, this behavior shows subgroup differences which parallel those for heavy drinking (Table 4).

Cigarettes

About two-thirds of all seniors have tried cigarettes sometime in their lives;[2] however, the much more important measures are those reflecting their current behavior: monthly prevalence (Table 3), and especially daily prevalence and half-pack-a-day use (Table 4). Half-pack daily use is highest among Native American seniors, significantly lower among Whites, and far lower among the other subgroups. In contrast to most other drugs, cigarettes have been used just as much by young women as by young men in recent years.

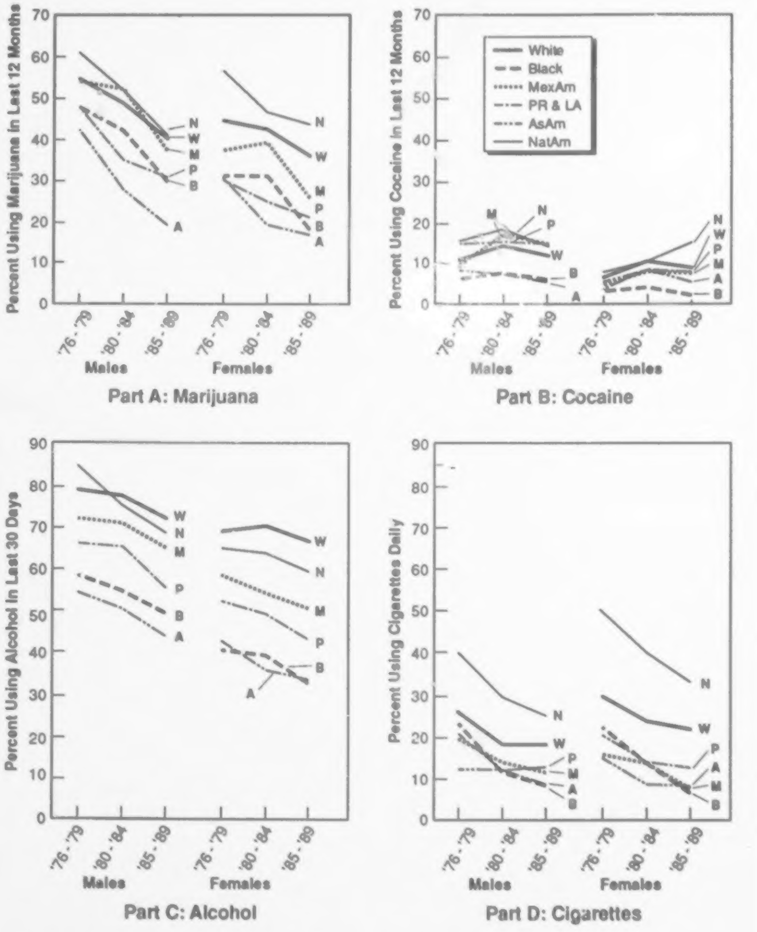

FIGURE 1—Trends in Use of Four Drugs, 1976–89, by Sex and Race

Trends in Prevalence of Drug Use, 1976–89

There have been a number of important increases and decreases in the use of various drugs since the mid-1970s, as we have reported in detail elsewhere.[2,7] Our purpose here is to consider whether some of the most important racial/ethnic subgroup distinctions observed in the classes of 1985–89 are relatively long-standing ones or reflect recent changes.

Illicit Drugs. Part A of Figure 1 shows that the downward trend in annual marijuana use occurred within all subgroups, and that subgroup differences were fairly consistent across time. Part B of Figure 1 shows the overall rise in cocaine use between the late 1970s and the early 1980s; the patterns of subgroup differences are not so consistent across time, but because of the generally small proportions of cocaine users we cannot be very confident in asserting different subgroup trends across time. Use of most of the other illicit drugs shown in Tables 2 and 3 declined during the past decade[2]; here again, the generally low proportions of users provide little basis for asserting *differential* subgroup trends across time. (Data for the earlier time periods are presented elsewhere.[8])

Alcohol. As Part 3 of Figure 1 indicates, 30-day prevalence of alcohol use has declined somewhat, especially among males, but subgroup differences were largely consistent across time.

Cigarettes. As shown in Part D of Figure 1, prevalence rates for daily use of cigarettes have declined for all subgroups. Substantial declines occurred between 1976–79 and 1980–84, whereas declines in recent years have been much smaller. Some groups (e.g., White males) showed no decline in recent years. In general, the declines in smoking have been stronger among non-White groups. Most notably, daily smoking prevalence rates of Black seniors dropped by two-thirds (from 23.6 percent to 8.6 percent for males, and 22.3 percent to 7.1 percent for females). Thus, Black-White differences in cigarette smoking have become more pronounced in recent classes of high school seniors.

Discussion

Although relatively little research compares drug use among racial/ethnic subgroups, the existing studies[7,9–20] yield a fairly consistent set of findings: Asian American youth tend to report very low levels of drug use relative to other groups. Black youth consistently report lower rates of drug use than White youth. Hispanic youth typically report more substance use than Blacks and only slightly less than Whites. Native American youth on average report greater use of alcohol and other drugs than any other subgroup.

The present findings are largely consistent with the literature. One contribution of the present research has been to document these differences based on large, nationally representative samples of high school seniors. Another contribution has been to demonstrate that for more than a decade the racial/ethnic subgroups have shown parallel trends, for the most part, in their use of alcohol and the illicit drugs. An important divergence in smoking rates (smaller declines among Whites) also has been noted.

Several important questions remain. First, are these replicated (and thus *reliable*) findings of subgroup differences also *valid*? In other words, how accurate are young people's self-reports of drug use in general, and are there reasons to suppose that subgroups may differ in accuracy? Second, how do the subgroups differ in dropout rates, and how do these differences affect our ability to generalize to total age cohorts? These are issues which have concerned us for some time, and they have made us cautious about reporting subgroup differences in drug use.[4] Although we have not fully resolved these questions, we have become increasingly confident that the subgroup differences reported here are, on the whole, valid.

First, with respect to self-reports of drug use, there is a growing literature indicating their validity.[21–25] Some questions may remain, of course, about the willingness of seniors to report their drug use honestly if they are not confident about the purposes of the research, if they do not trust the survey administrators, and/or if they have greater than average tendencies toward favorable self-presentation. Mensch and Kandel report that in the National Longitudinal Survey of Youth, which employed face-to-face interviews, Black and Hispanic youth were more likely than White youth to underreport their use of marijuana; however, this underreporting occurred most often at the lowest levels of use.[26] Incidentally, their initial analyses (based on total samples) revealed no underreporting of the licit drugs (i.e., alcohol and cigarettes), which show the largest subgroup differences in the present study.

Earlier analyses of Monitoring the Future data[8] revealed subgroup differences in rates of missing data and inconsistent responses; however, these differences do not parallel the subgroup differences in self-reported drug use. For example, Native American seniors have relatively high rates of missing data and/or inconsistent responses (6.6 percent for marijuana) as well as high self-reported drug use, whereas Black seniors have equally high rates of missing data and/or inconsistent responses (6.8 percent for marijuana), but much lower self-reported drug use. White and Asian American seniors are fairly similar in having low rates of missing data and/or inconsistent responses (2.3 percent and 3.1 percent, respectively, for marijuana), but their rates of drug use are distinctly different.

Additional analyses of Monitoring the Future data have shown that Blacks are more likely than Whites to perceive that drug use involves high risks, and to disapprove of drug use. Black seniors also are much less likely to report smoking, alcohol use, and drunkenness by friends, consistent with the large Black-White differences in self-reported drug use.* It is hard to imagine that these complexly interrelated findings are simply the result of selective distortion; in particular, it is unlikely that such distortion would result in much larger differences in self-reported use of the licit drugs compared with the illicit drugs. We find it more parsimonious to conclude that the substantial Black-White differences in self-reports are largely the result of genuine differences in drug use between our samples of Black and White high school seniors.

Even if self-reports are mostly valid across all of the subgroups studied, we are faced with further questions because our surveys do not include young people who drop out of high school before late spring of their senior year. Given that drug use is generally higher among dropouts, how different would findings be if based on the total cohort of 17- to 18-year-olds rather than just high school seniors? It is highly likely that the inclusion of dropouts would tend to raise the observed prevalence rates for all drugs and all subgroups. In addition, it seems fairly likely that the impact would be greatest in subgroups with high dropout rates, thus changing subgroup comparisons in several respects. First, Hispanics have higher than average dropout rates;[6] therefore, comparisons of *all* White and Hispanic 17- to 18-year-olds would probably yield somewhat smaller differences in drug use than found in samples of seniors. Second, Asian Americans have lower than average dropout rates[6]; accordingly, this subgroup might be even farther below average given drug use data based on the total age cohort rather than just seniors. Third, given the very high dropout rates among Native Americans,[6] total age cohort data might place them even farther above average in drug use. Fourth, Black-White differences in drug use might be reduced if we compared the total age cohort rather than just seniors; however, because Black and White dropout rates are now fairly similar,[6] the reduction would not be very large, unless drug use is differentially correlated with dropping out. It is also worth noting that recent household surveys, which do not omit dropouts, find Black-White differences in youthful drug use roughly as large as those reported here.[7]

If drug use really is lower than average among most non-White youth, an interesting question remains as to why this occurs. Multivariate analyses reported elsewhere[8] indicate that it cannot be attributed primarily to differences in parental presence or education, nor does it have a great deal to do with where seniors live throughout the United States. Some other dimensions of lifestyle we have measured have more bearing on drug use, but they do not account for most of the subgroup differences in use—especially the very low rates of cigarette and alcohol use by Blacks. Other possibilities which we have begun to explore, and will continue to examine, are that these relatively low usage rates are strongly influenced by particular religious doctrines and affiliations; differences in parent, peer, and community norms; different attitudes regarding the use of drugs; or differing levels of perceived risk.

The very low rates of drug use (particularly cigarette use and alcohol use) by Black students may be surprising, in light of evidence that drug-related mortality and morbidity are higher among Black than White adults.[1] These contrasting findings are, however, consistent with data from national household surveys comparing Blacks and Whites at various age levels: Black youth show much lower usage rates than White youth; in early adulthood differences are smaller; and by middle adulthood, the drug use/abuse rates are often higher among Blacks.[7,27,28]

It has been observed that "two worlds" of drug use (particularly alcohol use) exist within the Black community: the extremes of abstinence at one end and heavy use/abuse at the other.[27,29] As a result of heavy drug use by a minority (often having limited financial resources, health care, and insurance), Black adults are disproportionately represented in morbidity and mortality statistics, and data from public treatment centers. Such data, rather than findings from general population surveys, often serve as the basis for

Appendix

Measures

The use of alcohol and the use of each of the illicit drugs are measured by questions having the following format: On how many occasions (if any) have you used [name of drug category] . . .

a) . . . in your lifetime?
b) . . . during the last 12 months?
c) . . . during the last 30 days?

Seven response categories are available: 0 occasions; 1–2; 3–5; 6–9; 10–19; 20–39; 40 or more occasions. Annual and monthly prevalence refer to any use of the specific substance during the last 12 months, or the last 30 days, respectively. Daily prevalence refers to use on 20 or more occasions in the last 30 days. An additional question about heavy use of alcohol asks respondents how many times in the last two weeks they had five or more drinks in a row. Cigarette use is measured by a question which asks about use in the past 30 days (none, less than 1 cigarette per day, 1–5 cigarettes per day, about ½ pack per day, about 1 pack per day, about 1½ packs per day, 2 or more packs per day). There is a good deal of inferential data in support of the validity of such self-report measures of drug use, summarized elsewhere.[2,21-25]

The measure of racial/ethnic identification is based on the questionnaire item: "How do you describe yourself? 1. American Indian; 2. Black or Afro-American; 3. Mexican American or Chicano; 4. Puerto Rican or other Latin American; 5. Oriental or Asian American; 6. White or Caucasian; 7. Other."

conclusions about drug use among Black Americans. Our present findings clearly suggest that such data bases are too limited, and can yield a false picture of the subgroup as a whole.

But it is equally true that general population surveys do not provide an adequate basis for generalizations about the full range of drug use problems among Blacks, Whites, or any other racial/ethnic subgroup. Persons in drug treatment, the homeless, and those in prison are not represented in general population surveys. Additionally, dropouts, youth who are chronically absent, those in juvenile detention centers, and those who are homeless, are not well represented in samples of high school students. Here again, because minority group members make up disproportionate shares of most or all of these "high risk" populations, and because the levels of drug use in these populations are greater than average, it is widely believed that drug use is more pervasive among minorities than among Whites. While that remains a possibility among the dropouts, it now seems quite unlikely among young people who complete high school.

In sum, we are confronted with (at least) two worlds of drug use *data*. On the one hand, the findings from general population and school-based surveys clearly and consistently show relatively low levels of drug use by most non-White youth, especially Black Americans and Asian Americans. On the other hand, the public health statistics on mortality, morbidity, and treatment provide a somewhat different perspective. So perhaps our most important conclusion must be that neither form of data provides a complete picture of drug use. However, that should not overshadow the other important conclusion: the majority of non-White youth do complete high school, and among most of these individuals, usage rates for both illicit and licit drugs are lower than average. ☐

Acknowledgments

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Elevated Nicotine Levels in Cervical Lavages from Passive Smokers

Carol J. Jones, PhD, Mark H. Schiffman, MD, MPH, Robert Kurman, MD, Peyton Jacob III, PhD, and Neal L. Benowitz, MD

ABSTRACT

One hundred forty-five nonsmokers found to have normal cytologic diagnoses on routine Pap smears were interviewed regarding environmental exposure to tobacco smoke, and a 3 ml saline lavage of the cervix was collected for measurement of cervical nicotine levels by gas chromatography-mass spectroscopy. Nicotine levels tended to be highest among women exposed to tobacco smoke in the home, intermediate in women exposed only outside the home, and lowest in women recalling no exposure ($p = 0.001$). (*Am J Public Health* 1991;81:378–379)

Introduction

Women exposed to environmental tobacco smoke show biochemical evidence of smoke absorption in their saliva, serum, and urine.[1] A study of four women[2] recently reported that the cervical mucus of passive smokers might contain nicotine and its major metabolite, cotinine, concordant with the finding of increased concentrations of nicotine and cotinine in the cervical mucus of active smokers.[3,4] To confirm this report, we measured the concentrations of nicotine in cervical lavages taken from 145 cytologically normal, nonsmoking women, comparing concentrations in women passively exposed to tobacco smoke with those not exposed.

Methods

Subjects were part of a larger study of cervical neoplasia conducted in three Washington, DC area hospitals.[5] One hundred forty-five nonsmokers found to have normal cervical cytologic diagnoses on routine Pap smears were interviewed regarding environmental exposure to tobacco smoke, and a 3 ml saline lavage of the cervix was collected as previously described.[4] The interview included questions on the following topics: exposure to environmental tobacco smoke inside and outside the home in the previous 24 hours, time since last exposure, number of active smokers in the home, the smokers' relationship to the subject, and their usual intensity of smoking and products smoked (cigarette, cigar, pipe). The questionnaire focused on the 24 hours preceding specimen collection because previous research had indicated that cervical nicotine levels were correlated with active smoking during this period.[4] Specimens were kept frozen at −70° C until tested. All laboratory analyses were performed without knowledge of the smoking histories.

Nicotine was extracted from lavage samples by a modification of a published procedure.[6] The extracts were analyzed by combined gas chromatography-mass spectroscopy,[7] using a stable isotope-labeled analog, nicotine-d_4, as an internal standard. As a quality control measure, 17 aliquots of a pool composed of 19 cervicovaginal saline lavages, 17 from nonsmokers and two from smokers, were included among the specimens to be analyzed, with labels indistinguishable from the test specimens. The quality control data suggested that nicotine was measured reliably in the lavages. The mean of the 17 replicate measurements was 2.72 ng/ml with a coefficient of variation of 13.6 percent and a range of 2.2–3.5 ng/ml.

To classify subjects with regard to environmental tobacco smoke exposure, the following categories were formed: group 1 included women who reported exposure inside their homes within the past 24 hours, group 2 was comprised of women reporting exposure only outside their homes within the past 24 hours, and group 3 included women who recalled no exposure to environmental tobacco smoke in the previous 24 hours.

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TABLE 1—Nicotine Levels in Cervical Lavages from 145 Nonsmokers, according to Exposure to Environmental Tobacco Smoke over the past 24 Hours

Nicotine level (ng/ml)	*Group 1* (exposed at home)		*Group 2* (exposed only outside home)		*Group 3** (not exposed)	
	#	%	#	%	#	%
<0.2	5	15.6	6	14.3	22	31.4
0.2–0.3	7	21.9	14	33.3	21	30.0
0.4–0.7	4	12.5	10	23.8	20	28.6
>0.7	16	50.0	12	28.6	7	10.0
Total	32	100.0	42	100.0	70	100.0

Chi-square = 22.5, 6 degrees of freedom, p = 0.001

*Group 3 excludes one woman with an inadequate specimen.

Results

The study population was predominantly Black (63.5 percent); the median age was 30 years (range 16–66). Neither age nor race was associated with environmental tobacco smoke exposure.

A total of 32 women reported exposure to environmental tobacco smoke in the home (group 1), 42 reported exposure only outside the home (group 2), and 71 were unexposed (group 3). In group 1, 24 reported one active smoker in the home, five reported two active smokers, and three reported three or more active smokers in the home. Seven in group 1 recalled additional exposure to tobacco smoke outside the home.

Nicotine values ranged from below the limit of detection (<0.2 ng/ml) to 8.2 ng/ml. Nicotine levels tended to be highest among women in group 1 (exposed in the home), intermediate in group 2 (exposed only outside the home), and lowest in group 3 (not exposed). The median values for the three groups were: group 1, 0.8 ng/ml (range, <0.2–8.2), group 2, 0.4 ng/ml (range <0.2–5.2), and group 3, 0.2 ng/ml (range <0.2–3.8).

For grouped analysis, the nicotine levels were divided into approximate quartiles as shown in Table 1. The association of recalled environmental tobacco smoke exposure in the past 24 hours and detectable nicotine in cervical lavages was highly significant (p = 0.001).

Among the 38 women with exposure at home in the past 24 hours, there was no association observed between nicotine levels and the number of smokers to whom the women had been exposed, the usual smoking intensity of those active smokers, or the number of hours since last exposure. Moreover, for women exposed to smoke in the home, additional exposure outside the home was not related to nicotine level. Cigarette smoke accounted for virtually all of the exposure at home. Among women exposed only outside the home, there was no relationship observed between time since last exposure to environmental tobacco smoke and nicotine level.

Discussion

We observed a significant association between self-reported exposure to environmental tobacco smoke within the previous 24 hours and nicotine levels in cervical lavages from a group of 145 nonsmoking women. Exposure in the home resulted in the highest nicotine levels observed; however, women exposed only outside the home also had elevated levels of nicotine compared to those not exposed.

The biological significance of cervical nicotine levels resulting from passive exposure to tobacco smoke is not known. The levels of nicotine observed in nonsmokers most heavily exposed in our population were on average much lower than those seen in cervical lavages taken from active smokers. We found the median nicotine level in nonsmoking women exposed to environmental tobacco smoke at home to be 0.8 ng/ml (mean 1.1), ranging up to 8.2 ng/ml. We were unable to relate nicotine levels to more subtle distinctions, such as the intensity of home exposure. In contrast, using similar specimen collection and analytic methods, we observed a median value in 31 active smokers of 11.8 ng/ml (mean 34.3, range 2.8–383.4, unpublished data) and were able to correlate increasing intensity of active smoking with increasing cervical nicotine levels (Spearman's r = 0.46, p = 0.009). It is difficult to reconcile the relatively low levels of nicotine that we observed in passive smokers with the large magnitude of the relative risks reported by Slattery, *et al*, who found a risk from passive smoking similar to that of actively smoking women.[8]

It is remarkable, nonetheless, that even a relatively crude exposure categorization provided by questionnaire responses revealed a clear, albeit small, elevation of nicotine levels in the cervical fluid of passive smokers. This supports the idea that even low-level exposure to tobacco smoke in the environment may result in systemic effects, and suggests that passive smoking should be evaluated further as a risk factor for cervical disease. ☐

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Ascertainment of Maternal Deaths in New York City

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ABSTRACT

Maternal deaths in New York City are defined as deaths from any cause in a woman while pregnant or within six months of pregnancy termination. Pilot studies seeking to improve maternal death ascertainment found that selected medical examiner reports contributed an additional 10.5 percent of the total maternal deaths, vital statistics review contributed 6.3 percent, linkage of death tapes of women of reproductive age to live birth and fetal death tapes contributed 1.0 percent. Medical examiner cases should be incorporated into surveillance data for accurate ascertainment of pregnancy associated deaths. (*Am J Public Health* 1991;81:380–382)

Introduction

Maternal mortality, like infant mortality, serves as a sensitive indicator of the level of health and health care in a community. Speckhard, *et al*,[1] reviewed death certificates and medical records in Puerto Rico and found that the maternal mortality rate was increased by a factor of four in 1979. Starzyk, *et al*,[2] increased the ascertainment of maternal deaths in Washington state by 68 percent through linkage of birth and fetal death files with death certificates for all reproductive-aged women. In Georgia, an additional 27 percent of maternal deaths were identified via a similar vital record linkage system.[3] A conservative pooled estimate of the degree to which maternal deaths are underreported in the United States is by a factor of one-third.

In an effort to verify the efficacy of New York City's present ascertainment methods, which relies upon manual review of all death certificates and clinical records, we undertook three pilot studies to augment routine surveillance.

Methods

Routine Surveillance in New York City

New York City is one of 14 areas in the United States that includes a specific question, item #29 on the death certificate, to identify a pregnancy-associated death (Figure 1). The front of the New York City death certificate also lists coded items: ICD Code, Operative Code, Conditions of Interest Code. If pregnancy is mentioned anywhere on the death certificate, it should be reflected in one or more of the above codes. Routine surveillance relies upon manual review of all death certificates. If an associated pregnancy is indicated on the death certificate, hospital records and autopsy reports are requested and reviewed by an obstetrician. In New York City a maternal death is defined as the death of any woman dying of any cause while pregnant or within six months of termination of a pregnancy.

Death Certificate Review

All death certificates of women aged 10–49 who had died 1983–84 were manually reviewed in order to identify those deaths whose immediate cause was *not* coded in the ICD 630-676 range (complication of pregnancy, delivery or puerperium) but for which the coded items indicated association with pregnancy. All previously unidentified maternal deaths were verified by reviewing the hospital charts and autopsy reports. Additionally, the death certificates of previously reported maternal death cases were reviewed to assess whether all four items related to pregnancy had been completed. This review focused solely on the operative code and the conditions of interest code. It did not investigate those deaths where the ICD code might indicate a medical complication of pregnancy. This issue was addressed by reviewing selected medical examiners reports as will be described subsequently.

Linkage

The New York State Department of Health linked fetal death files and live birth files from 1983 and 1984 with death files of all New York City resident females ages 10–49 for these same years. Linkage was based on mother's last name, infant's last name or mother's first name being the same on both maternal and infant documents. All potential matches were verified for decedent's maternal status by the authors' review of available hospital charts and autopsy reports.

Medical Examiner Report Review

In New York City, there are approximately 3,000 autopsies performed annu-

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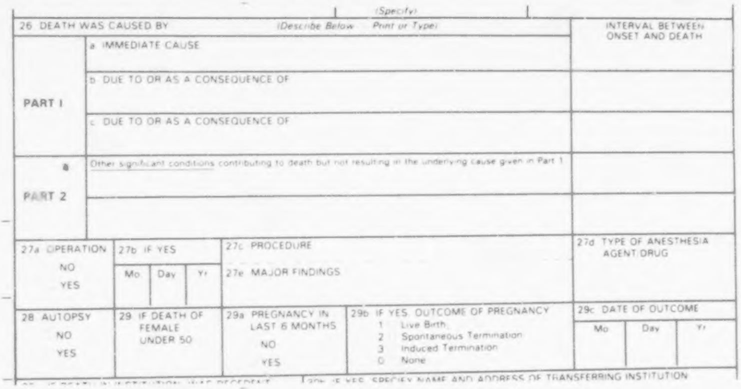

(Specify)

26 DEATH WAS CAUSED BY (Describe Below Print or Type)

INTERVAL BETWEEN ONSET AND DEATH

PART I

a IMMEDIATE CAUSE

b DUE TO OR AS A CONSEQUENCE OF

c DUE TO OR AS A CONSEQUENCE OF

PART 2

Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1

27a OPERATION NO YES

27b IF YES Mo Day Yr

27c PROCEDURE

27e MAJOR FINDINGS

27d TYPE OF ANESTHESIA AGENT DRUG

28 AUTOPSY NO YES

29 IF DEATH OF FEMALE UNDER 50

29a PREGNANCY IN LAST 6 MONTHS NO YES

29b IF YES, OUTCOME OF PREGNANCY
1 Live Birth
2 Spontaneous Termination
3 Induced Termination
0 None

29c DATE OF OUTCOME Mo Day Yr

IF YES, SPECIFY NAME AND ADDRESS OF TRANSFERRING INSTITUTION

FIGURE 1—New York City Death Certificate, Item #29.

ally on reproductive aged women by the Medical Examiner. Selected autopsies from 1983–84 were reviewed. A cause of death considered on clinical grounds to have a high probability of being a medical complication of pregnancy (Table 1) as well as drug-related deaths, homicides, and suicides were selected for review. Available hospital charts were subsequently reviewed to confirm whether or not there had been a recent pregnancy.

Results

A summary of maternal deaths identified by the three pilot methods is presented in Table 2. Six additional maternal deaths were found with only one of the coded items as the indicator of a pregnancy (i.e. solely the ICD, operative or condition of interest code reflected a concurrent pregnancy). Review of verified maternal deaths disclosed that Item #29 had not been completed in 40 percent of these cases. When death tapes of women of reproductive age range were matched with live birth and fetal death tapes, five possible matches were identified. However, review of the hospital charts and autopsy reports revealed only one of these women to have had a recent pregnancy. The results of reviewing the medical examiner's reports are presented in Table 3. These reviews yielded 10 additional pregnancy-related deaths, without any overlap with the other methods.

Adjustment of the maternal mortality rates* to reflect these findings involved a 16.6 percent rate increase in 1983, from 40.8 to 51.6/100,000 live births, and a 33 percent rate increase in 1984, from 24.1 to 32.6/100,000 live births. (A retrospective review of maternal mortality rates for New York City through 1987 reveals that the low rate in 1984 represents an unexplained variance, not a trend.)

TABLE 1—Medical Diagnoses that on Clinical Grounds are likely to be Medical Complications of Pregnancy, New York City 1983–84

Cause of Death	ICD Code	Number of Deaths among Women Aged 10–49 Years 1983	1984
Septicemia	038	11	12
Diabetes Mellitus	250	58	61
Immune Disorders	279	42	114
Coagulation Defects	286	4	2
Essential Hypertension	401	3	5
Hypertensive Heart Disease	402	17	30
Cardiomyopathy	425	18	10
Subarachnoid Hemorrhage	430	40	32
Intracerebral Hemorrhage	431	51	53
Phlebitis, Thrombosis	451	13	8
Other Venous Emboli and Thrombosis	453	4	3

TABLE 2—Identification of Pregnancy-associated Deaths, by Source, New York City 1983–84

	1983	1984
Current Surveillance Methods	49	29
Death Certificate Review	3	3
Birth Tape Linkage	1	0
Medical Examiner Reports	5	5
Total # Additional Cases	7	7
Revised No. Maternal Deaths	58	37
Percent Increase of Absolute Number	14.3	13.8

Discussion

Review of medical examiner reports proved to be the most useful approach to increasing the ascertainment of maternal deaths in New York City. Routine surveillance identified 82.1 percent of the 95 maternal deaths in 1983 and 1984; review of medical examiner reports contributed 10.5 percent; death certificate review contributed an additional 6.3 percent, linkage contributed 1.0 percent. Unlike Puerto Rico and Washington, ascertainment in New York City was not enhanced by the linkage system. This may reflect the population's high mobility and the alleged use of false names and addresses. A surveillance system utilizing linkage methods will not pick up those deaths associated with therapeutic abortions and ectopic pregnancies since fetal death certificates are not filed in these situations.

Both obstetrical practice and the risk profile of pregnant women have changed over the years. The additional cases identified by these pilot studies reveal some of the impact substance abuse and violence is having on pregnant women and new mothers. Elsewhere we have described human immunodeficiency virus (HIV) related maternal deaths in New York City not detected by routine surveillance.[4]

The results of these pilot studies suggest implementation of a system whereby the medical examiner, or hospital-based pathologist, notifies the maternal mortality surveillance team whenever evidence of a current or recent pregnancy is identified. Physicians filing death certificates need to be reminded to inquire about preg-

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*This rate is not a true rate but rather a *ratio* of deaths per 100,000 live births, i.e. the numerator describes something different than the denominator.

TABLE 3—Identified pregnancy-associated deaths from medical examiner reports by cause of death, New York City 1983–1984.

Category	# Cases Reviewed 1983	# Cases Reviewed 1984	# Cases Reviewed (Total)	# Pregnancy-Related 1983	# Pregnancy-Related 1984	# Pregnancy-Related (Total)
Medical Conditions	109	224	(331)	3	1	(4)
Drug-related	223	303	(526)	1	3	(4)
Assault, Suicide	102	36	(138)	1	1	(2)
Total	432	563	(995)	5	5	(10)
% Yield				1.15	.8	(1)

nancy history in all women in the reproductive age range and to complete certificates thoroughly.

As this nation has not met the Surgeon General's 1990 goals of no more than five maternal deaths/100,000 live births for any ethnic or geographic group,[5] it is an urgent matter to design preventive strategies. In order to do so effectively, it is imperative to ascertain all cases so as to accurately delineate the risk factors and causes of pregnancy-associated death. It is important to note that the New York City maternal death definition and surveillance is not universal. If a national surveillance system is to function effectively all registration areas need to utilize the same definitions as well as procedures. ☐

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Oral Public Health Programs for the Elderly: 1989

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ABSTRACT

Forty-eight of the 50 state dental directors, program managers, or state health officials were interviewed by telephone about the nature of current oral health programs for the elderly and factors that aided or hindered the development of such programs. Oral health programs for the elderly were reported in 30 states (63 percent of respondents). A majority of respondents indicated that a perceived or documented need for oral health programs for the elderly and lobbying by local advocacy groups were instrumental in implementing or planning such programs. (*Am J Public Health* 1991;81:382–384)

Introduction

The "graying of America" is a well-accepted phenomenon, as is its effect on the health care system.[1–5] Preventive oral health services and behaviors offer elderly people potential for enhancing the quality of life through improved chewing ability and reduced pain and infection of dental origin, for example. With a decrease in edentulism rates among succeeding cohorts of elderly[6] and an increase in dental utilization,[7] older adults are likely to seek oral health care in greater numbers than did their parents. The U.S. Surgeon General's Workshop on Health Promotion and Aging noted that additional activities are needed in the areas of oral health education and services for older adults,[8] areas falling within the purview of state and local health agencies.

Out-of-pocket reimbursement is the primary method of payment by older adults for dental care.[9] Of the three principal government health care programs, Medicare provides essentially no dental coverage, and the Veterans Administration limits dental coverage to eligible veterans; although Medicaid provides dental coverage for indigent adults in 43 states, 17 states limit benefits to emergency care, denture services, or both.[10]

At the local level, some agencies have begun to allocate resources to the oral health needs of older adults. Kuthy and Odom reported in 1988 that 16 (of 127) local programs provided clinical services in nursing homes and that oral health education programs were offered by 39 (of

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TABLE 1—Distribution of Oral Public Health Programs for Elderly Persons by Proportion of State Population over 65 Years of Age

	Proportion of State Population Over 65 Years Old		
Program Type	≤10% (n = 14)	11 to 12% (n = 20)	≥13% (n = 16)
Clinical care	3	0	2
Health education	3	5	6
Combination[a]	4	6	1
Total	10	11	9

[a]Both clinical care and hearing education.

125) agencies.[11] Evans found that 35 percent of local dental programs reported providing health education programs at senior centers.[12]

At the state level, no recent information is available on oral health programs for older adults. Miller, *et al*, reported that 50 percent of state health agencies had statutory authority to provide dental health services.[13] A 1983 study of state health agencies identified 20 nonclinical geriatric dental initiatives.[14]

The objectives of this project were to determine the extent and nature of current and proposed oral health programs for older adults and to identify factors that had facilitated or hindered the development of such programs.

Methods

A structured interview was designed to address the study objectives and then revised based on several reviews for clarity and content by a panel of professionals in dental public health, geriatric dentistry, research design, and program evaluation.

All known state dental directors or dental program managers were contacted, first by letter and later by telephone, to arrange a mutually convenient time for the interview. In states without a dental director or program manager, another health department administrator was contacted. All data provided by respondents were considered confidential and are reported here in aggregate form only.

Results

A total of 48 state dental directors, managers, or administrators completed interviews, yielding a 96 percent response rate. Although the interviews were subject to the limitations of self-report surveillance, interviews revealed that some level of oral health programming for older adults existed in 30 states (63 percent of respondents).

A variety of oral health education or promotion activities were provided by 25 of the 30 states, primarily in long-term care facilities. Clinical services were provided to the elderly by 16 of the 30 states, with 3 states having direct responsibility and 10 states offering services jointly with a local agency. In the remaining states, clinical services were provided through arrangements with local educational institutions and dental associations or through loans of portable equipment to private dentists. Of the 18 states without programs for older adults, 6 planned to implement health education or prevention programs within 3 years; 2 of the 6 also planned a clinical component.

In the majority of states with programs, two factors that assisted in the development of programs were identified: a perceived or documented need for oral health programs, and a local advocacy group that lobbied for programs. Obtaining funds that could be used for older adult programs assisted program development in most of the states planning programs.

Low state priority for providing oral health services to older adults and funding restricted to population groups other than older adults were identified by a majority of respondents as hindering the development of older adult programs.

Independent variables including proportion of the state population over age 65, total number of elderly persons in the state, eligibility of elderly to participate in the state Medicaid program, and size of the state dental budget were examined to determine their utility as predictors of a state program. However, none of the independent variables predicted the presence of a state oral health program for the elderly. Table 1 shows the distribution of oral health programs by states in which the elderly population was the same, higher, or lower than the national average of 11 to 12 percent. No evident relation of program and population can be seen.

Discussion

Although changes in dental health care priorities seem inevitable, they must be preceded by careful needs assessment, so that resources are allocated to the most compelling problem areas. To understand the scope of such problems, the needs assessment process should include development of a data base on the dental needs of older adults, both perceived and observed; identification of dental services available to or needed by older adults; and identification of the ranking of dental care on a list of health priorities.

Oral health programs for older adults that were reported to be more comprehensive shared the following three characteristics: a commitment by the state agency to provide oral health programs for older adults, active interest by organized dentistry, and some form of linkage with the local aging network (such as local Area Agencies on Aging or a state Department of Aging). The scope and magnitude of the physical, psychological, and socioeconomic problems encountered by the elderly in obtaining and paying for oral health care make the support of this triad vital to the successful development and implementation of oral health programs for older adults.

A majority of respondents perceived that lobbying by local advocacy groups had assisted in implementing oral health programs and that the lack of such an organized group was a hindrance. This area is one where appropriate assistance must be offered; access to dental consultants with gerontologic training could be extremely helpful to state agencies in their work with diverse advocacy groups. Dental public health can have a significant role in improving the quality of life for the elderly by using the health promotion and prevention skills that improved the oral health of younger populations. ☐

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Effect of Pregnancy during TMI Crisis on Mothers' Mental Health and Their Child's Development

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ABSTRACT

Five years after the Three Mile Island nuclear accident, the mental health of women who had been pregnant and living within 10 miles of Three Mile Island at the time of the accident was similar to that of women from the same area who became pregnant after the accident. Ratings of the development of the two groups of children when they were 5 years old were also similar. However, women who were pregnant during the crisis and had been "extremely disturbed" about their pregnancies rated their children's health as poorer than did the women who were pregnant later. (*Am J Public Health* 1991; 81:384–386)

Introduction

A review of published research on the psychological and social effects of the Three Mile Island (TMI) accident showed that women living near the facility who were pregnant or had young children were among those who experienced the greatest psychological distress following the accident.[1] A study conducted by the Pennsylvania Department of Health showed little biological effect of the accident on women who were pregnant during the crisis and on their children.[2]

Five years after the accident, the Pennsylvania Department of Health conducted follow-up studies to assess long-term physical and psychological impacts of the TMI crisis on these same women and children. We report here interviews with the mothers concerning their perceptions of their children's health and development and their own mental health.

Method

The study and control cohorts consisted of 7,433 women who gave birth within 2 years of the TMI accident and lived in communities within 10 miles of the nuclear facility at the time of the births. A 50 percent random sample of each of these cohorts was selected: 1,880 mothers who gave birth within 12 months of the TMI accident; and 1,850 mothers who gave birth from 13 to 24 months after the accident. The latter group served as controls. Mothers who had moved out of the area since their children's births, as well as mothers who still lived in the vicinity of TMI, were interviewed. A 97 percent response rate was achieved for each sample,

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TABLE 1—Multiple Regression Analyses Comparing Ratings of Mothers' and Children's Health by Mothers in the Study and Control Groups (N = 2,585)

Dependent Variables	Regression Coefficients for Study-Control Comparisons[a]	Standard Error
Ratings of child's health (high score = poor health)	.0438	.0185
Number of child's visits to physician in past year	.0536	.0317
Developmental profile (high score = poor development)	.0310	.0685
Preschool behavior scale (high score = emotional problems)	.0241	.0211
Ratings of mother's health (high score = poor health)	−.0000	.0174
Mother's depression score	.0151	.0095
Mother's anxiety score	.0147	.0088

Notes: Covariants are listed in text. N varies slightly with number of missing values for each dependent variable. [a]Control group = 0, study group = 1.

TABLE 2—Analyses of Covariance of Mothers' Mean Ratings of Their Children's Overall Health by Timing of Pregnancy and Disturbance about Pregnancy

Disturbance about Pregnancy	Pregnant During Crisis	Pregnant After Crisis	P value of Difference
Extremely disturbed	2.17 (N = 327)	1.95 (N = 87)	.0236
Somewhat disturbed	1.88 (N = 667)	1.94 (N = 478)	.3358
Not disturbed	1.69 (N = 388)	1.71 (N = 638)	.7284

Note: Health was rated 1, excellent; 2, very good; 3, good; 4, fair; or 5, poor. Covariants are listed in text.

yielding 1,833 pairs of mothers and children in the study sample and 1,808 pairs in the control sample.

The analyses reported here involved women who were pregnant at the time of the accident, i.e., those who gave birth during the 9 months after the accident (study group), and those who gave birth during the corresponding 9 months a year later (control group). The study group was interviewed in 1985 when the index children were 5 years old, and the members of control group were interviewed in 1986 when their children were also 5 years old.

The dependent variables analyzed were the number of physician visits,[3] the developmental profile for 5-year-old children,[4] the preschool behavior scores suggestive of emotional problems,[5,6] the mothers' anxiety and depression scores,[7,8] and the mothers' overall ratings of their children's and their own health.

Results

We fitted multiple regression models with terms for study versus control group, month of child's birth, child's sex, child's birth order, mother's marital status, time mother spends caring for child, mother's education, mother's employment status, mother's race, mother's age, household size, and distance of home from TMI at the time of the crisis. Dependent variables were log transformed to adjust [illegible] skewness.

Table 1 shows that all but one coefficient (mother's health) are in the direction suggesting poorer status for the study group. Only one coefficient, however, mothers' overall ratings of their children's health was statistically significant. Women who gave birth within 9 months of the accident gave their children's health poorer mean ratings than women who gave birth in the same months a year later.

Examination of the distribution of these general health ratings showed that the difference in the two groups was largely in the percentage of mothers who rated their children's health as "excellent"; that percentage was 7 percent lower among the study mothers than among controls. We also examined interactions among the study and control groups' ratings and mothers' age, birth order of the child, and mothers' education while controlling for the same 11 covariants. No interactions were statistically significant.

Mothers were grouped based on how disturbed they said they had been about their pregnancies when they were interviewed 5 years earlier, shortly after their children's births (Table 2). The poorer health ratings were primarily among mothers who had been "extremely disturbed" about their pregnancies. The statistic for this interaction effect had a probability of .0635. The difference between the two groups was significant only for the "extremely disturbed" group.

Discussion

The interview data reported here are primarily subjective and indicate how the experience of being pregnant during the TMI crisis affected the mothers' views of their children and themselves. Although the findings showed a poorer status for women who were pregnant during the crisis, the differences between this group and the controls were small. The only notable difference was in the smaller proportion of study group mothers who rated their children's health as "excellent." Small but statistically insignificant differences between women who were pregnant during the crisis and women who became pregnant afterward were found for long-term anxiety, long-term depression, ratings of the children's development, and reports of children's physician visits.

Women who were pregnant during the crisis and who were also "extremely disturbed" about their pregnancies tended to rate their children as less healthy. This pattern is similar to that reported by Roht, *et al*, who found that people living near toxic waste sites were more likely to report health problems if they believed that the sites could affect their health.[9] Roht, *et al*, interpreted their findings as an example of response bias induced by the expectations of the respondents.

The present findings can be interpreted similarly: that is, the mothers of children born within 9 months of the TMI accident, who were "extremely disturbed" because of possible long-term effects of radiation released during the accident, may have paid special attention to their children's health problems, resulting in the general impression that their children were less healthy. Whether these children were less healthy than controls will be investigated further in a medical record review study now in progress. ☐

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Using a State Cancer Registry to Increase Screening Behaviors of Sisters and Daughters of Breast Cancer Patients

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ABSTRACT

The Pennsylvania Cancer Registry was used to contact breast cancer patients and, through them, their adult sisters and daughters. The sisters and daughters were counseled concerning their higher than average risks for breast cancer and their need for mammography and breast self-examination. Results showed a 9 percent increase in mammography and a 10 percent increase in breast self-examination rates for the counseled over control group. Costs were $49 per counseled sister or daughter indicating a need to increase cost effectiveness before implementation is practical. (*Am J Public Health* 1990; 81:386–388)

Introduction

Cancer registries have contributed to the treatment and prevention of cancer by making it possible to study the distribution of the disease, its causes, and the planning of services.[1,2] Women whose mothers or sisters have had breast cancer have two to three times the usual risk for developing breast cancer in their lifetimes.[3] We used the registry to contact breast cancer patients and through them first degree female relatives in order to counsel them about what to do to ensure early diagnosis and treatment of breast cancer, should it be found.

Methods

Potential participants were sisters and daughters of breast cancer patients diagnosed between June 1982 and June 1984 and living in eight counties in central Pennsylvania. Names of all breast cancer patients from four counties were obtained from the Pennsylvania Cancer Registry at the beginning of the study and randomly assigned to three groups where sisters and daughters were to be counseled in years 1, 2 and 3, respectively, of the project. At the end of the first year, four additional counties were added to the study and randomly assigned to the years 2 and 3 groups. At the end of 21 months, the knowledge, attitudes and behavior of sisters and daughters of breast cancer patients in all three groups were assessed using telephone interviews. Those who had received counseling in the first 21 months were "experimental," while those yet to be counseled were controls. This design controlled for the effects of media attention and public education programs that occurred during the first 21 months of the study.

Permission to contact the patients was obtained from the physicians listed on the cancer registry forms. When permis-

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sion was given, patients were contacted and asked for access to their sisters and adult daughters living in Pennsylvania who were then reached and counseled by telephone. Counseling consisted of asking questions about their knowledge, attitudes, and behaviors related to breast cancer and, where responses were not consistent with American Cancer Society (ACS) guidelines, explaining and discussing the reasons for the guidelines. The counselors urged the sisters and daughters to follow ACS guidelines because of their risks for future breast cancer and the excellent prognosis when cancer is discovered at an early stage.

All sisters and daughters were invited to attend education sessions held throughout the eight-county study area and were encouraged to come in family groups. The education sessions included explanations of breast cancer risks, the importance of breast self-examinations (BSE) and mammography as well as opportunities to practice BSE on model breasts and on themselves.

Results

Characteristics of the experimental and control groups are shown in Table 1. The control group had a lower physician permission rate, fewer early stage diagnoses, and more recent diagnoses. One-third of experimental group women attended the voluntary teaching sessions in their communities.

Table 2 reports estimated effects of the experimental treatment on general knowledge of breast cancer, breast self-examination, and mammography. Multiple linear regression was used to make comparisons between the groups based on continuous outcomes, and multiple logistic regression was used to make comparisons based on dichotomous outcomes. All analyses adjust for index patient's stage at diagnosis and year of diagnosis and the respondent's age, education, and whether she was a sister or a daughter. Treatment effects were parameterized as the additional effect of treatment on the mean response for continuous outcomes, and as the relative odds for treated versus control for dichotomous outcomes. As the table shows, all comparisons favored the treatment group, although the effects were not large.

We also investigated a number of possible interactions including: whether those who attended the group sessions showed a greater change in screening behaviors than those who did not attend; whether sisters

TABLE 1—Characteristics of Study Populations

Patients	Experimental	Control
Total number selected[a]	611	395
MD permission given	431 (71%)	221 (56%)
Pts who agreed to participate	302 (70%)	165 (75%)
Number with eligible sisters or daughters[b]	160	111
Mean patient age[b]	62	61
Stage of disease at diagnosis[b]		
Stage I	4%	4%
Stage II	70%	53%
Stage III	25%	40%
Stage IV	1%	3%
Year of diagnosis[b]		
1982	27%	14%
1983	56%	48%
1984	17%	38%
Sisters and Daughters		
Total number participating	370	242
daughters	46%	48%
sisters	54%	52%
Mean age	48	46
Education		
Less than high school	26%	24%
High school graduate	45%	48%
Post high school	29%	28%

a) Excludes patients who died before evaluation interviews or were living outside of Pennsylvania.

b) Excludes patients without sisters or daughters, or where sisters and daughters were less than 18 years of age or were living outside Pennsylvania.

TABLE 2—Sisters' and Daughters' Knowledge and Behaviors Concerning Breast Cancer[a]

	Experimental Group	Control Group	Estimated Treatment Effect (95% CI)[e]
Information[b]			
Mean percent of correct answers on general information about breast cancer	71%	65%	6.83% (4.51, 9.15)
Mean percent of correct answers on signs of breast cancer	30%	24%	6.75% (4.61, 8.90)
Breast Self-examination[b]			
Confidence in ability to do BSE (0 = not at all, 3 = very)	2.23	2.04	.20 (.07, .32)
			Relative Odds (95% CI)[f]
Percent doing BSE monthly or bimonthly	49%	39%	1.53 (1.08, 2.17)
Mammography[c]			
Percent ever having a mammogram	57%	52%	1.36 (0.91, 2.03)
Percent who had a mammogram since receiving education[d]	39%	30%	1.57 (1.03, 2.40)

a) Controlling for the index patient's stage at diagnosis and year of diagnosis and the respondent's age, education and whether she was a sister or daughter.

b) Experimental group N = 369, Control group N = 242.

c) Only sisters and daughters ages 35 and older. Experimental group N = 269, control group N = 185.

d) Experimental group women were asked if they had a mammogram since their telephone education and the control group was asked the date of their most recent mammogram. Persons in the control group were scored positively if they had a mammogram in the past 21 months, which was when experimental group education occurred.

e) Continuous outcome: additional effect of treatment on mean response when all other factors are held constant.

f) Dichotomous outcome: relative odds for treated versus control respondents when all other factors are held constant.

responded differently to the program than daughters; whether higher socioeconomic status women responded differently than lower socioeconomic status women; whether younger women responded differently than older women; and whether the index patient's stage of disease at diagnosis was related to the program's impact. None of these variables interacted significantly with the experimental/control variable in their effects on the sisters' and daughters' breast self-examination, ever having a mammogram, or having a mammogram since receiving education. We also investigated whether the eight counties were significantly different on any of the outcome measures. They were not.

Cost estimates, based on hours spent by project personnel, were $49 per sister or daughter counseled. Twenty-five percent of these costs were expended in obtaining physician permissions, 50 percent in obtaining patient permissions and counseling relatives, and 25 percent was for supervision and secretarial support.

Discussion

The medical and demographic differences between the experimental and control groups may be the result of when subjects were recruited. Since the control group was recruited last, they had the greatest gap between diagnosis and recruitment which may have contributed to their lower physician permission rate and lower participation among patients with early stage at diagnosis.

The findings indicate that the program did affect participants' knowledge, attitudes and behaviors, although the impact on behavior was generally modest. Moreover, only half of the eligible sisters and daughters were counseled due to high physician (29 percent) and ~~patient (30~~ percent) refusal rates. At the time of the evaluation interviews, 43 percent of counseled sisters and daughters over age 35 had never had a mammogram. Similar findings have been reported with other groups at high risk for cancer.[4,5]

The control group mammography rate of 52 percent is also of interest because it is about 10 percent higher than has been reported for the population as a whole[6,*] suggesting that a substantial number of these high-risk women had already taken action to deal with their increased risks. This may have limited the potential impact of the program.

If this program were implemented statewide in Pennsylvania, assuming the same physician and patient refusal rates, the cost would be approximately $227,000 yearly. If, as in this study, there was a 9 percent increase in mammogram rates and, assuming a 1 percent yield of cancers detected (double the usual rate because of working with a high risk population), four cancers would be discovered earlier than otherwise at a cost of $56,963 per diagnosis. The real costs may be lower than these estimates since the excess in mammography rates could be assumed to occur in subsequent years as well. Furthermore, costs of recruiting physicians might also be lower in future years because physicians' increased familiarity and experience with the program might result in more responses to first requests, thereby requiring less follow-up effort. An alternative approach could be to ask physicians to voluntarily refer high-risk patients to the education program. This would reduce recruitment costs and possibly increase patient participation, but would make the program more dependent on physician cooperation. We conclude that it is feasible to use a state cancer registry to contact and counsel first degree relatives of cancer patients, but that additional work is needed to increase the program's cost effectiveness. ☐

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Cost-Effectiveness of Alpha-1 Antitrypsin Replacement Therapy in Treatment of Congenital Chronic Obstructive Pulmonary Disease

6T

Joel W. Hay, PhD, and Eugene D. Robin, MD

ABSTRACT

Background: Alpha$_1$-antitrypsin (AAT) replacement therapy is an expensive intervention ($20,000–$30,000 per patient annually) which may slow or arrest the progression of chronic obstructive pulmonary disease (COPD) in AAT-deficient patients. While FDA-approved, therapy efficacy is unknown. The costs and benefits of AAT replacement therapy were evaluated for patients with congenital COPD.

Methods: Epidemiological and disease cost data were taken from published sources. A discrete-time model of disease stage probability transition was developed to calculate the present-value expected cost of disease treatment, under a range of possible therapy efficacy and other parameter values.

Results: At an efficacy of 70 percent, the cost per life year saved with AAT replacement therapy would be between $28,000 and $72,000 (1990 US dollars), depending on patient age, sex, and smoking status. At 30 percent efficacy, the cost per life year saved range would be between $50,000 and $128,000. A controlled efficacy study would cost $53 million or less, if the true efficacy were 50 percent or better.

Conclusions: With efficacy of 30 percent or higher, therapy cost-effectiveness would be comparable to other widely used medical interventions. The economic assessment methodology was used to evaluate both the therapeutic innovation and the value of additional clinical research. (*Am J Public Health* 1991; 81:427–433)

Introduction

More than 10 million Americans are afflicted with chronic obstructive pulmonary disease (COPD). It has been estimated that roughly 1 percent of this condition is caused by congenital alpha$_1$-antitrypsin (AAT) deficiency.[1] AAT is a human protease inhibitor which acts in the interstitial lung tissues to prevent damage caused by neutrophil elastase. In addition to COPD, AAT deficiency leads to other clinically significant disorders, including hepatic complications in about 10 percent of patients.[2,3]

In a prospective Swedish study, 8 percent of 183 AAT-deficient eight-year-old children had asthma or bronchitis in the previous year.[4] The mean age for onset of dyspnea, presumably related to COPD itself, was 40 to 45 years in patients with AAT deficiency. The mean life expectancy was 50 to 65 years. Smokers with AAT deficiency experienced a more rapid clinical course, with age at onset of symptoms and age at death advancing by more than a decade relative to nonsmokers.[3]

Human alpha$_1$-proteinase inhibitor (Prolastin) has been approved by the Food and Drug Administration (FDA) for replacement therapy in emphysema patients with congenital AAT-deficiency. Because of the small potential market, it has been granted "orphan drug" status. AAT replacement therapy has been shown to improve the levels of AAT in serum and epithelial tissue.[5] The clinical efficacy of AAT replacement therapy in slowing congenital COPD progression is not yet known.

Unusual policy issues are raised in examining the efficacy and cost-effectiveness of this therapy, with its small number of potential beneficiaries. Because a prospective randomized clinical trial to determine outcome efficacy could cost over $1 billion (see below), health care providers and patients must use other means to decide whether or not to make use of a medication of high cost and unknown benefit. This lack of detailed data on therapeutic risk and benefit arises often, since many forms of medical therapy are used in the absence of controlled clinical trials.

Despite the uncertainties regarding therapeutic outcomes, new immunoassays for AAT-deficiency blood screening are under development (E. Silverman, personal communication, January 1990). Several public health agencies are examining population screening, including the state of Oregon, which is considering adding AAT-deficiency screening to its list of required blood tests for newborns (S. Buist, personal communication, May 1990).

No prior studies have specifically addressed the medical costs associated with AAT deficiency. Previous studies have found the medical and economic costs of COPD to be substantial,[5,7] Oster et al. reported the average medical costs per patient year to range from $587 to $6,238 (1990 dollars) for COPD patients, depending on the number of years after onset of symptoms.[7] In a prospective study of the medical costs for treatment of COPD, Strauss *et al*[8] and Bergner *et al*[9] reported costs averaging $14,647 per year (1990 dollars). The Bergner *et al* study sample was limited to homebound patients with both a

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Editor's Note: See also related editorial p. 414 this issue.

TABLE 1—Cost Effectiveness of AAT Replacement Therapy for Smokers and Nonsmokers

Age	Life Expectancy (undiscounted years)*	Present Value of Average COPD Medical Costs ($1000s)	Present Value of AAT-Replacement Therapy Costs ($1000s)	Therapeutic Increase in Life Expectancy (undiscounted years)	Cost per Life Year Saved ($1000s)
PiZ Males					
Smoking					
30	13.97	$ 82	$456	22.42	$33
40	9.78	$ 96	$403	18.91	$33
50	6.69	$106	$335	14.99	$32
60	7.14	$ 85	$287	9.28	$39
70	2.59	$109	$182	7.99	$28
Nonsmoking					
30	32.06	$ 27	$504	9.76	$64
40	24.47	$ 34	$459	8.63	$64
50	17.93	$ 39	$398	7.12	$68
60	12.82	$ 38	$328	5.31	$72
70	7.45	$ 48	$236	4.59	$57
PiZ Females					
Smoking					
30	17.79	$ 71	$485	24.09	$33
40	11.96	$ 89	$436	21.45	$32
50	9.28	$ 95	$382	16.88	$34
60	7.68	$ 95	$317	12.05	$36
70	5.50	$ 92	$242	8.33	$36
Nonsmoking					
30	32.43	$ 29	$520	13.84	$50
40	22.69	$ 47	$472	13.94	$45
50	13.79	$ 74	$400	13.73	$41
60	10.66	$ 74	$336	9.97	$44
70	7.27	$ 71	$258	7.09	$43

*Source: Adapted from Larsson[3]

COPD diagnosis and Forced Expiratory Volume (FEV_1) scores below 60 percent of normal, a severely impaired group.

Using a societal perspective to measure costs and benefits, we applied available data on congenital COPD incidence, prevalence, patient survival, and costs of COPD medical treatment to cost-effectiveness evaluation of therapy. By examining the cost-effectiveness of AAT replacement therapy under alternative efficacy assumptions, we consider whether determination of therapeutic efficacy would itself be cost-justified. Possible strategies for population screening of congenital AAT-deficiency are also briefly considered.

Methods

We estimated costs per life-year saved (CLYS) for homozygous (PiZ) AAT-deficient individuals: the ratio of the change in expected net COPD medical cost resulting from AAT replacement therapy relative to the change in years of life saved through the intervention (see Appendix).[10-12] Future costs and benefits were discounted to current age using a discount rate of 5 percent.[11-14]

The best available evidence on the natural history of disease in AAT-deficient individuals was reported by Larsson, based on 1 to 14-year follow-up data for 246 Swedish adults with PiZ AAT-deficiency.[3] Column one of Table 1 adapts Larsson's survival data to the adult US population using 1986 US vital statistics. Early estimates of the median survival subsequent to diagnosis of COPD were consistently around five years among subjects with an initial FEV_1 close to 1.0 liter.[15,16] A more recent study by Burrows *et al* shows longer overall survival, but with substantial differences across COPD subcategories.[17] In atopic subjects or nonsmokers with known asthma, the ten-year mortality rate (not age adjusted) was 15 percent, while for smokers with an emphysematous form of COPD, the ten-year mortality rate was 60 percent. Since the mean age in the Burrows *et al* study population was 63, the ten-year survival for the milder forms of COPD was presumably little different from that for non-COPD individuals. The eight-year median survival for emphysematous smokers reported by Burrows *et al* probably more closely matches the prognosis for AAT-deficient patients after COPD diagnosis. While long-term use of therapy might improve or impair the quality of life, we use change in survival as the prime criterion for therapeutic efficacy and outcome assessment.

COPD Medical Care Costs

Several studies show that AAT-deficient individuals tend to develop relatively severe forms of COPD.[1-3] We used the Bergner *et al* and Strauss *et al* medical care cost estimates.[8,9] In their multivariate estimates, annual costs of care did not change with physician specialty, type of hospital (federal or community), insurance coverage, age, sex, income, entry FEV_1 score, length of study participation, or death of patient.[8,9]

The Bergner *et al* and Strauss *et al* study subject inclusion criteria, patient survival, and patient demographic characteristics matched those of the Burrows *et al* study fairly closely, suggesting that a six- to 10-year median COPD patient survival with annual medical costs of $12,000 to $16,000 (1990 dollars) would characterize the course of COPD after diagnosis in AAT-deficient individuals. Conservatively, since no estimates are reported in the recent COPD cost studies, we ignored diagnostic and treatment costs associated with respiratory disease prior to development of FEV_1 values below 65 percent of normal, or with other symptoms outside the Burrows *et al* emphysematous subject category definition. As shown below, this downward bias on the medical cost estimates would have little impact on the CLYS estimates.

Table 1, column two shows the present value of lifetime expected COPD medical care costs, estimated by attributing average excess medical costs per year over the eight-year median survival period prior to death for the fraction of excess deaths due to COPD in each age-, sex-, and smoking-adjusted five-year interval for PiZ cohorts (see Appendix).

AAT Replacement Therapy Intervention

Human alpha$_1$-proteinase inhibitor (Prolastin) is prepared from human plasma screened for hepatitis B and human immunodeficiency virus (HIV) antibodies and heat-treated for at least 10 hours. Hepatitis B vaccine is recommended for all

TABLE 2—Cost per Year of Life Saved by AAT-Deficiency Replacement Therapy at Patient Age 40 ($1,000s)

Outcome Efficacy	PiZ Males		PiZ Females	
	Smoking	Nonsmoking	Smoking	Nonsmoking
10%	$107	$352	$107	$214
30%	$ 50	$128	$ 49	$ 83
50%	$ 38	$ 83	$ 38	$ 56
70%	$ 33	$ 64	$ 32	$ 45
90%	$ 29	$ 53	$ 28	$ 38

recipients, and hepatitis B immune globulin is recommended for recipients who have not yet developed adequate antibody titers.

Prolastin is infused intravenously once per week at a dosage of 60 mg/kg. The current medication cost is $0.10 per mg, or $20,000 per year for a 64 kg adult.[18] The safety record for Prolastin has been described as excellent to date.[19] We assumed average annual costs would be $30,000 to include pharmacy markup, physician monitoring, intravenous infusion, and treatment of side effects. We also assumed that, once initiated, therapy would be maintained throughout the patient's life.

We found no data relating Prolastin in treatment of COPD to improvement in patient outcome. Wewers *et al,* in a study of the safety and biochemical efficacy of Prolastin, provided 507 infusions to 21 PiZ homozygous AAT-deficient patients.[5] They found fourfold increases in AAT serum and epithelial lining fluid levels and doubling in anti-neutrophil elastase capacities subsequent to infusion, but these changes may not reflect improved patient outcome.

AAT-deficiency also produces liver disease, hemorrhagic disorders, pancreatic fibrosis, and other less frequent symptoms.[2,3] Prolastin has shown efficacy in treatment of panniculitis in PiZ patients.[20] However, no efficacy has been suggested for Prolastin for other non-COPD disorders associated with congenital AAT deficiency.[2]

It is not known whether congenital COPD can be fully prevented, somewhat slowed, or merely delayed, so it would be inappropriate to assign a specific value for the outcome efficacy of AAT replacement therapy in treatment of congenital COPD and/or other clinical disorders caused by congenital AAT deficiency. Instead, we have opted to define a hypothetical "outcome efficacy" in terms of the percentage of potential normal survival (age-, sex-, and smoking-status-adjusted) that could be salvaged through therapeutic intervention, and to show the cost-effectiveness of AAT replacement therapy at different "outcome efficacy" values ranging from 0 to 100 percent. That is to say, for each five-year age interval, we define the "outcome efficacy" as x percent if the AAT-deficient individual's probability of survival during that period has increased by x percent relative to a normal (non-AAT-deficient) individual (see Appendix). We do not attempt to detail the specific clinical pathways whereby these hypothetical survival benefits would be achieved.

Results

Table 1, column three shows the net present value of lifetime expected AAT replacement therapy costs in thousands of dollars assuming an "outcome efficacy" of 70 percent. Lifetime therapy costs can only be estimated contingent on efficacy level, since lower efficacy levels will reduce the patient's survival probabilities and thus lower the lifetime expected cost of therapy. The figures in column three also net out the savings in medical treatment of COPD due to reduced probability of disease. Column four shows the change in life expectancy associated with a 70 percent "outcome efficacy" for each age-, sex-, and smoking-status-adjusted cohort. Column five provides CLYS estimates for each adjusted cohort under the assumptions described above, including 70 percent "outcome efficacy," 5 percent time discount rate, eight-year median survival from time of COPD diagnosis, $30,000 annual cost of AAT replacement therapy, $14,647 annual medical cost for treatment of COPD, and a healthiness weight of 75 percent (of normal) applied to average reported days of excess restricted activity (see Appendix). The CLYS values ranged from $27,624 to $71,945; for smoking males and females, most CLYS values were at or below $40,000, while for nonsmoking males and females they were $41,000 to $72,000.

It is a bit puzzling that the CLYS would be as low as $28,000 when the annual AAT treatment cost is $30,000. However, based on the Larsson data, compared with normals, the relative risk of death for PiZ smokers is extremely high, ranging from 27:1 for 35-year-old PiZ male smokers to 4:1 for 60-year-olds. For the individuals at highest risk, after discounting future costs and benefits, and netting out the avoided COPD medical costs (Table 1, column two), at hypothetical "efficacy" levels of 70 percent, $30,000 of therapy buys about a year of additional life expectancy.

To put results shown in Table 1, column five in perspective, they are within the range of such values reported for a number of generally accepted medical interventions. For example, adjusting to 1990 US dollars, Drummond reported that treatment of hypertension in 40-year-old males would cost $30,200 per year of life saved, estrogen therapy for postmenopausal women would cost $42,600, single-vessel coronary bypass would cost $57,400, and hospital hemodialysis would cost $85,400.[10] Kinosian and Eisenberg reported that antihypercholesterolemia therapy would cost between $20,500 and $135,000 per year of life saved, depending on heart disease risk factors.[11]

Table 2 shows the impact of alternative "outcome efficacy" assumptions on AAT replacement therapy CLYS values, holding all other parameters at the same values as in Table 1, column five, for 40-year-old adults. At 10 percent "outcome efficacy" the CLYS estimates exceeded $100,000 but at 90 percent "outcome efficacy" they dropped to less than $30,000 for PiZ smokers. Even if AAT replacement therapy were able to improve congenital COPD survival probabilities by a relatively low 30–50 percent, the values would still be within the range calculated for other frequently used medical interventions, particularly for PiZ smokers.

Sensitivity Analysis

Table 3 shows the effects of 40 percent changes in each key model parameter. The CLYS results are fairly stable. Of the five key model parameters shown, only changes in the annual cost of AAT replacement therapy induced as much as a one-for-one percentage change in CLYS values. Thus, with the exception of assumed "outcome efficacy" (Table 2) and therapy cost, the results were not highly sensitive to underlying modeling assumptions.

TABLE 3—Sensitivity Analysis of Base-Case Model CLYS Values: Effects of ±40 Percent Change in Each Parameter

	PiZ Males (Age 40)		PiZ Females (Age 40)	
	Smoking	Nonsmoking	Smoking	Nonsmoking
Base-Case Value	$32,572	$63,869	$31,959	$44,823
	% Change in Base-Case CLYS Values			
Time Discount Rate				
Base Case: 0.05%				
+40%	−8.7%	−14.4%	−9.2%	−12.6%
−40%	10.4%	20.1%	11.6%	17.9%
Median Survival from Onset of COPD				
Base Case: 8 YEARS				
+40%	−6.7%	−4.3%	−7.1%	−5.7%
−40%	5.9%	3.8%	6.4%	5.2%
Annual Cost of AAT Replacement Therapy				
Base Case: $30,000				
+40%	44.2%	41.7%	43.7%	42.0%
−40%	−44.2%	−41.7%	−43.7%	−42.0%
Annual Cost of COPD Medical Care				
Base Case: $14,647				
+40%	−4.2%	−1.7%	−3.7%	−2.0%
−40%	4.2%	1.7%	3.7%	2.0%
Restricted Activity Day Quality Weight*				
Base Case: 75%				
+33%	2.5%	4.5%	5.1%	6.7%
−40%	−2.9%	−4.9%	−5.5%	−7.0%

*It is assumed that the upper bound on health value of restricted activity days is 100% (= 133% of 75%).

TABLE 4—Economic Assessment of Randomized Clinical Trial Outcomes

Outcome Efficacy	Expected Five-Year Mortality Difference	Minimum Study Arm Sample Size (Power = 80%)	Outcome Efficacy Study Cost ($ Millions)	Cost per Life Year Saved
10%	0.015	10,200	$1,530	$216,572
30%	0.046	1,000	$ 150	$ 85,543
50%	0.077	350	$ 53	$ 59,024
70%	0.108	150	$ 23	$ 47,324
90%	0.139	80	$ 12	$ 40,440

Should an Outcome Efficacy Study Be Done?

We can now consider the costs and benefits of undertaking a clinical trial to establish efficacy of AAT replacement therapy. It has been estimated that demonstration of a statistically significant therapeutic efficacy in slowing the decline of lung function would require a clinical trial involving 300–500 patients over a five-year study period.[21] Generally, the value of a randomized controlled clinical trial depends on the prior probability distribution of successful trial outcomes, the size of treatment effect needed to show clinical benefit, and the relative rates of outcome events (e.g., deaths) in treatment and control patients.[22–25] In the case of the already approved AAT therapy, there are penalties associated with not establishing therapeutic efficacy irrespective of the true value. If the true outcome efficacy is very high, many potential beneficiaries may be missing an important medical intervention. If the efficacy is low, then it may be that too many dollars are already being devoted to an expensive but ineffective therapy.

Table 4 considers the design parameters of a randomized controlled trial to evaluate AAT replacement therapy efficacy. Based on the PiZ survival estimates described above, the average five-year mortality probability for a PiZ cohort age 30–60, with equal numbers of men and women and 30 percent smokers would be 18.4 percent. Greater study efficiency would result if the study were targeted to higher risk patients by age, sex, or smoking status, but the generalizability of the findings would then be suspect. For each hypothetical "outcome efficacy," the second and third columns of Table 4 show, respectively, the expected five-year mortality difference and the minimum study sample size needed per study arm to achieve 80 percent power (20 percent risk of false negative results) with a two-sided alpha significance level of .05.[24,26]

Table 4, column four, shows the cost of the study under the assumption that each patient in the AAT therapy arm would require five years of therapy at $30,000 per year. Additional study monitoring, data collection and analysis costs would be trivial relative to these therapy costs. Given that the annual NIH research budget is around $7 billion, less than $3,400 per fatality, study samples needed to detect "outcome efficacy" levels below 30 percent would be prohibitively expensive, particularly since the therapy might partially benefit only 50,000 to 100,000 individuals.

The economic analysis implies that clinical and statistical considerations are not sufficient design criteria in this case. Table 4, column five shows the average CYLS from AAT therapy at each "outcome efficacy" level, assuming that it would be impossible to restrict access to medication by age, sex, or smoking status if the therapy were found to be significantly effective in extending life expectancy. As shown, the "outcome efficacy" of AAT therapy would have to be 50 percent or better to be cost-effective relative to other medical therapies and thus to be economically viable. Detecting economically justifiable therapeutic benefits would thus require smaller sample sizes than would be implied by focusing exclusively on clinical decision criteria. Alternatively, to achieve greater efficiency, the clinical trial could be targeted by age, sex, smoking status, or other risk factors, and if successful, the therapy usage indications could be similarly restricted.

TABLE 5—Projected Costs of Screening for PIZ Emphysema in Various Subpopulations (All Figures in Millions)

	Relevant Adult Population	Cigarette Smokers	Subjects with Established Emphysema	Relatives of Patients with Emphysema	Relatives of Patients with Alpha-1 Antitrypsin Globulin
Estimated Size of Population	100	30	10	20	0.5
Cost of Screening (Dollars)	10,000	3,000	1,000	2,000	50
Cost of Follow-up (Dollars)	1,000	300	100	200	166
Number of False Positives	1	0.3	0.1	0.2	0.005

Congenital COPD Screening Strategies

The availability of a new therapy also raises the issue of the cost-effectiveness of screening to detect early disease and to institute therapy to prevent or retard progression. With rare diseases such as AAT deficiency, the assumed screening rate of false positives has a major impact on the value of screening programs. There are two types of false positive measurements. Technical false positives relate to problems in the performance and interpretation of clinical tests. Biological false positives occur in subjects with a given biochemical or genetic abnormality that is never expressed in frank disease. We assumed that the rate of the former was 1 percent, which is conservative for most tests. We also conservatively chose to ignore biological false positives. However, in a small sample, 25 percent of PiZ homozygotes showed little evidence of COPD.[3] In another study, nonsmoking PiZ homozygotes demonstrated substantial variability in FEV measurements and in COPD prevalence, suggesting a high rate of biological false positives.[1]

We examined some alternative populations that might be screened, estimated false positive rates, and evaluated the screening costs (Table 5). We conservatively ignored the follow-up and treatment costs for false positives. Since only 50,000 to 100,000 individuals in the United States are potentially treatable, some of these screening strategies would add significantly to the cost of intervention, even if Prolastin were highly efficacious. Choice of screening strategies should therefore await more precise efficacy calculations.

Discussion

COPD in congenitally AAT-deficient individuals is a severe, life-threatening illness. AAT replacement therapy leads to promising biochemical improvements in serum and lung-fluid measurements. Our analysis showed that if AAT replacement therapy were able to narrow the age- and sex-adjusted survival probability gap between PiZ and normal individuals by at least 30–50 percent, the cost-effectiveness of AAT replacement therapy would be comparable to widely used medical interventions, including antihypertensive medications, coronary bypass, antihypercholesterolemia medications, and estrogen replacement therapy. It seems apparent that smoking avoidance by AAT-deficient nonsmokers and cessation among AAT-deficient smokers would be highly clinically effective and cost effective as primary preventive strategies.

The results presented here are somewhat conservative in calculating benefits for several reasons. First, it is likely that a large percentage of adults would be able to receive AAT replacement therapy at an annual cost less than $30,000, even when the cost of treating side effects is included. Also, it is likely that improvements in therapeutic administration and reductions in the cost of producing Prolastin will occur as new technologies are developed. Additionally, COPD medical costs and patient survival after the onset of symptoms are likely to continue their upward trends; both of these developments would enhance the cost-effectiveness of therapy designed to reduce or delay the probability of COPD incidence. Because of lack of data, we did not include any medical costs for mild stages of COPD disease. However, based on our sensitivity analysis, this last bias is probably quite small: a 40 percent increase in annual medical costs (or in missed medical costs) would only improve the estimated therapy benefits by 2–4 percent (Table 3). Finally, because of data and methodology limitations, we have ignored important positive and negative quality-of-life considerations, including those associated with routine IV therapy and with the pain and suffering of avoided disease.

More precise cost-effectiveness values could be calculated if we knew whether AAT replacement therapy is effective in improving patient outcome and, second, whether it merely halts progression of disease or improves lung function. Most of the anatomical changes associated with AAT deficiency are considered irreversible. We also need to know whether the use of AAT replacement therapy before clinical disease onset will prevent the development of emphysema in later life. If therapy is found to be efficacious, the timing of therapy initiation in relation to the course of COPD disease will also be of crucial clinical and economic significance. These issues can only be resolved by randomized, controlled, prospective double-blind studies. Such studies should antedate any widescale use of therapy or broad-based screening programs.

Randomized controlled clinical trials of AAT therapy designed to detect minimally significant clinical differences might inadvertently allow for ineffective economic results. The "outcome efficacy" survival benefits would have to be substantial for the intervention to be readily cost-justified. Such benefits could be detected in a relatively small clinical trial. Similar economic considerations would also have implications for other therapies and biomedical research issues. ☐

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TABLE A.1—Proportion of Persons Alive at Beginning of Interval Who Died during Interval

Age (years)	PiZ Males		US	PiZ Females		US
	Smoking	Nonsmoking	Males	Smoking	Nonsmoking	Females
25–29	0.2200	0.1800	0.0083	0.0100	0.0030	0.0030
30–34	0.1893	0.0514	0.0095	0.1111	0.0039	0.0039
35–39	0.2555	0.0300	0.0118	0.1562	0.0055	0.0055
40–44	0.3254	0.0856	0.0166	0.1641	0.0087	0.0087
45–49	0.3696	0.0684	0.0254	0.4639	0.0568	0.0142
50–54	0.5714	0.1143	0.0409	0.1960	0.2009	0.0229
55–59	0.5045	0.1892	0.0651	0.6625	0.3066	0.0355
60–64	0.3571	0.1236	0.0985	0.5386	0.3553	0.0547
65–69	0.5645	0.3190	0.1429	0.2217	0.2162	0.0806
70–74	0.9821	0.2678	0.2135	0.4916	0.3489	0.1229
75–79	1.0000	0.6489	0.3044	0.8203	0.5742	0.1875
80–84	1.0000	1.0000	0.4315	1.0000	0.8081	0.2993
85+	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

SOURCE: C. Larsson and National Center for Health Statistics (see references[3] and [8]).

APPENDIX

CLYS cost-effectiveness estimates have been developed for a number of medical technologies and thus provide a convenient and widely accepted comparative perspective on this intervention relative to other well-known medical interventions.[10-12] CLYS values provide estimates of the net cost of saving one additional year of life. CLYS is measured as:

$$\text{CYLS} = \Delta C / \Delta Y. \tag{1}$$

The net change in COPD medical cost, ΔC, includes the present value of lifetime AAT replacement therapy costs plus costs of treating any therapeutic side effects, while subtracting out the average savings in COPD treatment costs resulting from reduced probability of disease. The increase in life years resulting from intervention, ΔY, is calculated as the average increase in patient life expectancy, plus a fraction of the average reduction in patient COPD disability days.

Emphysema patients report more days of restricted activity and work loss than average, even after age- and sex-adjustment. National Center for Health Statistics data on the annual age- and sex-specific number of restricted activity days associated with emphysema are 66.8, 0.1, and 28.7 for men age 21–40, 41–60, and 61 or older, respectively, and are 143.8, 0.6, and 26.2 for women 21–40, 41–60, and 61 or older, respectively.[27] Quality-adjusted life year (QALY) measurements are often used to weigh episodes of illness (in days) with 1 representing perfect health and 0 representing death.[12] Various methods have been developed to calculate QALY weights. We arbitrarily chose to weigh restricted activity days at 75 percent of healthy days in our base-case analysis. As shown in Table 2, since the average number of emphysema disability days is small relative to the average reduction in life expectancy, any weight between 0 and 1 has little impact on cost-effectiveness estimates. It should be pointed out, however, that CLYS estimates that disregard change in disability days would implicitly assume that a day of illness is equivalent to a day of health.

Change in survival was calculated by adjusting Larsson's age-, sex-, and smoking-status-adjusted five-year PiZ hazard rates by the ratio of age- and sex-adjusted US average population hazard rates to Swedish non-PiZ subject hazard rates (see Table A.1). Column one of Table 1 has projected this survival data to the reductions in life expectancy associated with AAT deficiency for age-, sex-, and smoking-status-adjusted US cohorts.

CLYS Estimates

The CLYS estimation equations can be described iteratively, just as they are calculated in a computer spreadsheet. Abstracting from sex and smoking status variations, let λ_t be the discrete mortality hazard at patient age t for intervals of length τ (e.g., $\lambda_t = 0.22$ in the five-year interval for smoking males age 25-29; Table A.1). Then L_t, the discounted life expectancy at age t obeys;

$$L_t = D_{\tau/2}\lambda_t\,(\tau/2 - \delta) +$$

$$D_\tau[(1 - \lambda_t)\,(\tau d + L_{t+1})], \tag{2}$$

where D_τ and $D_{\tau/2}$ are the time discount factors for time intervals of length τ and $\tau/2$, respectively; δ is the estimated cumulative time lost due to disability, discounted forward from the median time of COPD diagnosis to the midpoint of the τ-year interval when death from COPD occurs, and d is a survivor discount factor to adjust the τ years of survival forward to the end of the interval. Equation (2) contains discrete-time approximation errors, since we are assuming that the average death occurs at the midpoint of the time interval, when it is actually more likely to occur somewhat later in the interval. Also, as in the US Vital Statistics tables,[28] all individuals over age 85 are combined into final sex-specific age categories. These simplifications do not substantially affect the results.

Let λ_t^p be the τ-year hazard for a (sex-, smoking-adjusted) PiZ individual, λ_t^e be the τ-year hazard associated with a therapeutic efficacy of 100e percent, and λ_t^n be the τ-year hazard for a normal individual. Then we define "outcome efficacy" as;

$$\lambda_t^e = \lambda_t^p - (\lambda_t^p - \lambda_t^n)e. \tag{3}$$

One hundred percent efficacy would mean normal survival and 0 percent efficacy would mean the same mortality hazard as an untreated PiZ individual. Using equation (2), we define L_t^e to be the estimated life expectancy with therapy and L_t^p to be life expectancy without therapy. ΔL_t^e, the change in life expectancy at age t associated with a therapeutic "outcome efficacy" of e, would then obey;

$$\Delta L_t^e = L_t^e - L_t^p. \tag{4}$$

In the absence of therapy, excess medical costs due to PiZ-related COPD would obey:

$$M_t = D_{\tau/2}[(\lambda_t^p - \lambda_t^n)\,C_1] +$$

$$D_\tau[(1 - \lambda_t^n)\,M_{t+1}], \tag{5}$$

where C_1 are the medical costs for treating fatal COPD discounted forward to time of death. The base-case analysis assumes that an average COPD fatality would experience a course of illness requiring annual medical treatments costing $14,647 per year during an eight-year period prior to death. This is a conservative estimate of medical costs, since costs are excluded for PiZ-related disease insufficiently severe to cause death, and for COPD prior to illness severity meeting the criteria in the Strauss *et al*, Bergner *et al* and Burrows *et al* studies.[6,9,17] As detailed in the text above, these downward biases on our medical cost estimates do not have a large effect on the CLYS calculations.

Under therapy, the medical and intervention costs due to PiZ-related COPD would obey;

$$M_t^e = D_{\tau/2}[(\lambda_t^e - \lambda_t^n)\,(C_1 + C_2/2)] +$$

$$D_\tau[(1 - \lambda_t^e)\,(C_2 d + M_{t+1}^e)], \tag{6}$$

where C_2 are the τ-year therapeutic intervention costs, including treatment of side effects or adverse reactions, discounted to the midpoint of the interval. In our base-case analysis, these are assumed to be $30,000 per year, or $146,733 per five-year interval using a 5 percent discount rate.

ΔM_e^e, the change in medical costs at age t associated with a therapeutic "outcome efficacy" of e, would obey;

$$\Delta M_t^e = M_t^e - M_t. \tag{7}$$

Thus, our measure of CLYS associated with a therapy of "outcome efficacy" e is $\Delta M_t^e / \Delta L_t^e$.

Clinical Trial Power Calculations

The two-tailed power estimate $1 - \beta$ for clinical trial sample sizes with a significance level of $\alpha = .05$ is calculated using the binomial probability formula;

$$\beta = \Phi\{\,[N^{1/2}(P_0 - P_1)]/[[P_0(1 - P_0) +$$

$$P_1(1 - P_1)]^{1/2}] - 1.96\}, \tag{8}$$

where $\Phi\{\cdot\}$ is the cumulative normal distribution function, N is the sample size per treatment arm, P_0 is the (five-year) control group mortality rate, and P_1 is the treatment group mortality rate.[23]

Population Screening Cost Estimates

The estimated screening costs were calculated for the US population. It was assumed that, excluding the young and the elderly, there were about 100 million adults who might be considered for screening. Of these, roughly 30 percent would be current or recent smokers, and 10 percent would be emphysema patients. Twenty percent would be geneal relatives of emphysema patients. Screening costs, including follow-up testing of initial positives were estimated at $110 per screenee. It was assumed that the full battery of screening tests would be performed for all geneal relatives (assumed to average 3.3) of identified AAT-deficient adults. As described in the text, we assumed a false positive rate of 1 percent.

Regular Source of Ambulatory Care and Access to Health Services

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ABSTRACT

Background: To examine why people lack a regular source of ambulatory care (RSAC) and explore whether this commonly used access measure accurately identifies population subgroups at risk for barriers to continuity care.

Methods: Using data from a 1986 national telephone survey, we performed a content analysis of subjects' verbatim reports as to why they lacked an RSAC (n = 5,748).

Results: The 16.4 percent of respondents who lacked an RSAC gave the following reasons: 1) financial problems, 8 percent; 2) local resource inaccessibility, 5 percent; 3) not wanting a regular source of ambulatory care, 61 percent; and 4) transitory loss of their regular source of ambulatory care, 18 percent. However, some sociodemographic subgroups reported substantially more problems with access barriers, and these disparities were often not detected by the global measure, RSAC. The poor were not more likely than the non-poor to lack an RSAC (odds ratio [OR] = 0.8; 95% confidence interval, [0.6, 1.1]), but were much more likely to lack an RSAC for financial reasons (OR = 5.2 [2.6, 10.6]). Similarly, rural respondents were not more likely than urban dwellers to lack an RSAC, but were more likely to lack an RSAC because of local resource inaccessibility (OR = 5.8 [2.8, 11.9]).

Conclusions: We conclude that the global measure, RSAC, is not an accurate indicator of whether population subgroups have access barriers to obtaining a source of continuity care. (*Am J Public Health* 1990; 81:434–438)

Introduction

Substantial effort and funds are devoted to monitoring access to health services in the United States.[1–10] Whether or not people have a regular source of ambulatory care has been a traditional measure in surveys on access and use of health services.[4–7,9,11–12] It has been recognized that access problems, such as financial barriers and provider unavailability, are not the only reasons for not having a regular source of ambulatory care.[13–14] Yet this indicator is often used to compare the access to continuity of care for different sociodemographic subgroups. It is sometimes assumed that the absence of a regular source of ambulatory care is primarily accounted for by access barriers. Whether or not this characteristic identifies groups that are at high risk of not receiving continuity of care because of access barriers has not been critically evaluated.

To evaluate the usefulness of this indicator as a measure of health services access, we analyzed data from the 1986 Robert Wood Johnson Foundation's access to health care survey. The analyses had three main objectives: 1) to identify the reasons Americans lack a regular source of ambulatory care; 2) to examine whether or not such reasons vary by demographic subgroup; and 3) to determine if the absence of a regular source of ambulatory care identifies sociodemographic subgroups at high risk for not obtaining continuity of care because of access barriers.

Methods

This 1986 national telephone survey used random-digit dialing and had a response rate of 76 percent. The Waksberg screening procedure was used to minimize the number of nonworking numbers dialed.[15] Persons with chronic or serious medical illnesses were oversampled to allow for adequate evaluation of access problems of persons with major health problems. The results presented are weighted to produce estimates for the US population. Detailed descriptions of the weighted-probability sampling technique have been published previously,[5,8,10,16] and the interview and schedule data are available from the Inter-University Consortium for Political and Social Research at The University of Michigan. Weighted and unweighted sample sizes by social characteristics are presented in the appendix.

As part of the survey, each interviewee was asked, "Is there one person or place in particular you usually go to when you are sick or want advice about your health?" Those who answered "no" to this question were asked: "Many people do not have one particular place to get medical care. What is the reason that you do not have a regular doctor or place to go?" Interviewers were instructed to record the responses to this item verbatim.

The survey on access to health care sampled 10,130 Americans, but verbatim responses were stored for a subset of the

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TABLE 1—Proportion of Respondents Lacking a Regular Source of Ambulatory Care (RSAC)

	No RSAC	
	n	%
All Respondents	5,748	16.4%
Ages (in yrs.)		
1–12	821	6.4%
13–22	591	19.9%
23–44	1,985	23.7%
45–64	1,318	14.0%
≥65	1,010	9.2%
Health Status		
Excellent/Good	4,833	16.9%
Fair/Poor	887	12.7%
Sex		
Male	2,404	20.9%
Female	3,329	12.2%
Household Income		
Poor	442	18.4%
Near Poor	492	15.8%
Non-poor	3,977	16.0%
Insurance Status		
Insured	4,965	14.8%
Uninsured	450	31.2%
Race or Ethnicity		
Black/Hispanic	695	20.7%
White/Asian	4,809	15.5%
Place of Residence		
Urban	4,813	17.7%
Rural	795	15.3%
Education		
Non-High School Graduate	358	17.6%
High School Graduate	4,337	16.1%
College Graduate	552	18.6%

interviewees; this subset consists of consecutive cases obtained by random-digit dialing (n = 5,748), and there are no substantive differences between this subset and the overall sample with respect to key variables (regular source of ambulatory care, age, sex, geographic region, income, ethnicity, or insurance status).

To aid in developing a classification system for categorizing verbatim responses, we asked 20 health care providers to list reasons that people lack a regular source of ambulatory care. This generated a list of 82 specific reasons. This list was then simplified into a five-category classification structure: 1) financial problems; 2) local resource inaccessibility; 3) did not want a regular source of ambulatory care (divided into four subgroups, described below); 4) transitory loss of their regular source of ambulatory care; and 5) no response or response not classifiable. Pilot testing of a sample of actual responses revealed high reliability, and reviewers did not feel that further revisions of the classification structure were needed.

Financial problems included being unable or unwilling to pay the expected cost of medical care. Local resource inaccessibility included those who reported an inadequate supply of health care providers in their area or who reported logistical problems with getting care (i.e., problems with parking, transportation, or contacting their health care provider).

Two investigators (RAH and AMB) independently reviewed and categorized all verbatim responses. Inter-rater agreement was 96 percent for classification into the five main categories and 94 percent for classification into categories and subcategories. Upon joint review, most disagreements were easily resolved, and when reviewers continued to differ, the response was designated as non-classifiable.

Analyses were performed on five dependent variables: 1) the proportion who did not have a regular source of ambulatory care, and the proportion who lacked a regular source of ambulatory care because of 2) financial problems; 3) local resource inaccessibility; 4) not wanting one; and 5) transitory loss of a regular source of ambulatory care. Each variable was broken down according to eight respondent characteristics: age, sex, self-reported health status, household income, ethnicity, education, medical insurance status, and urban vs. rural residence. For respondents age 22 or younger, main wage earner's education was used.

We also evaluated associations between having a regular source of ambulatory care and receipt of cervical and breast cancer screenings;[10] seeking a physician for serious medical symptoms;[17] and needing medical, surgical, or supportive medical care and not being able to obtain it.[5,8] We measured receipt of care for serious symptoms using a method developed by Shapiro et al.[17–18] Each respondent was asked serially about one of five serious symptoms: 1) shortness of breath with light exercise or light work: 2) chest pain while exercising; 3) loss of consciousness; 4) abnormal bleeding; and 5) weight loss of 4.5 kb. or more not caused by dieting. Subjects who reported one or more serious symptoms during the past month were reported as having sought care if they had contacted a physician for any of the symptoms.

Results

Overall, 17.0 percent of respondents reported not having a regular source of ambulatory care. However, analysis of verbatim responses found that 0.6 percent of these respondents had misunderstood the question and actually had a regular source of ambulatory care. Most errors were due to subjects thinking they were being asked if they saw their doctor regularly (i.e., "I have a family doctor, but I don't go in that often."). Correction of these errors did not alter any of the associations between a regular source of ambulatory care and the respondent characteristics. This paper presents results using corrected responses.

After correction for the errant responses, we found that 16.4 percent of all respondents lacked a regular source of ambulatory care (Table 1). Bivariate comparisons showed that those aged 13 to 44 were more likely than other age groups to lack a regular source of ambulatory care. Also, not having a regular source of ambulatory care was more common among the uninsured, those in excellent or good health, males, Hispanics and Blacks.

Table 2 shows the reasons respondents lacked a regular source of ambulatory care, as a percentage of those lacking a regular source of ambulatory care and as a percentage of the total sample. Of the 841 respondents who reported not having a regular source of ambulatory care, 8 percent reported not having one because of

TABLE 2—Reasons for Lacking a Regular Source of Ambulatory Care (RSAC)

Reason for Not Having an RSAC	Percent of Those Who Lack an RSAC (n = 841)	Percent of All Respondents (n = 5,748)
Financial problems	8	1.4
Local resource inaccessibility	5	0.8
Did not want an RSAC	61	9.9
No health problems	41	6.7
Use alternative health care	5	0.8
Don't like to go to the doctor	5	0.8
Prefer multiple sources of care	7	1.1
No explanation	3	0.5
Transitory loss of RSAC	18	2.9
No response/unintelligible	8	16.4%
Lack an RSAC	100%	16.4%

financial barriers, and 5 percent because of local resource inaccessibility. In contrast, 61 percent reported not wanting a regular source of ambulatory care; most of these reported not having perceived a need for care. In addition, 18 percent reported a transitory loss of their regular source of ambulatory care, and 8 percent had no answer available. Overall, 2.2 percent of all respondents reported lacking a regular source of ambulatory care because of financial barriers or local resource inaccessibility (Table 2).

To evaluate the relative associations between the respondents' sociodemographic characteristics and the dependent variables (no regular source of ambulatory care and the four reasons people reported not having a regular source of ambulatory care), we computed logistic regression models for each dependent variable (Table 3). Respondents aged 13–44 were more likely than those in other age groups not to have a regular source of ambulatory care. This difference was distributed among the four reasons for lacking a regular source of ambulatory care (Table 4). Those in excellent or good health were more likely to lack a regular source of ambulatory care, chiefly because of not wanting one. Men were more likely than women to lack a regular source of ambulatory care due to a greater likelihood of having financial problems, not wanting a regular source of ambulatory care, and transitory loss of their regular source of ambulatory care (Table 3). The uninsured were more likely than the insured to lack a regular source of ambulatory care, due to a greater likelihood of having financial problems, not wanting a regular source of ambulatory care, and transitory loss of their regular source of ambulatory care.

The poor were not found to be more likely than the non-poor to lack a regular source of ambulatory care, but were more likely to lack a regular source of ambulatory care for financial reasons (Table 3). Similarly, level of education and place of residency were not associated with having a regular source of care, however, those with less education were more likely to report a financial barrier to obtaining a regular source of ambulatory care, and rural respondents were much more likely . . ." Level of education was even less likely to be associated with having a regular source of ambulatory care, but those with less education were more likely to report a financial barrier to obtaining a regular source of ambulatory care (Table 3). Yet rural respondents were much more likely to lack a regular source of ambulatory care because of local resource inaccessibility (Table 3). In all these instances, the global measure, regular source of ambulatory care, failed to identify those with greater risk for having access barriers to a regular source of ambulatory care.

However, lacking a regular source of ambulatory care was a risk factor for not receiving recommended medical care (Table 4). Those who did not have a regular source of ambulatory care were less likely to have received breast and cervical cancer screening and to have seen a physician when they had a serious medical symptom, and they were more likely to report being unable to obtain medical or surgical care they needed during the past year. They were also less satisfied with the medical care they had received.

Discussion

Whether or not people have a regular source of ambulatory care has been a commonly used process measure of access and is used as an indicator of whether the respondent has a source of continuity of care. Having a regular source of ambulatory care is felt to be particularly important for those with chronic conditions as well as for maternity and child care. Whether having a source of continuity of care improves efficiency or promotes better quality of care has not been well studied, and our results do not shed light on this issue. However, we did find that lacking a regular source of ambulatory care identifies a group that is less likely to receive recommended health services and that is less satisfied.

The presence or absence of a regular source of ambulatory care is also used to evaluate different population subgroups' access to obtaining a source of continuity of care. In this study, we found that the global measure, regular source of ambulatory care, could not be relied upon for this purpose. First, we found that most people who lack a regular source of ambulatory care do not report access barriers as the reason. Only 13 percent of those who lacked a regular source of ambulatory care reported problems with finances or availability of local health care providers, whereas 61 percent reported not wanting one. Although each study employed slightly different classification structures, our findings of why people lack a regular source of ambulatory care are consistent with previous reports.[13–14]

Second, in most instances, regular source of ambulatory care was a poor indicator of which groups were more likely to have access barriers to obtaining continuity of care. For instance, rural respondents were no more likely than urban respondents to lack a regular source of ambulatory care; however, a rural residence was the only major risk factor for having problems with local resource inaccessibility. Therefore, relying upon the global measure would be misleading in terms of the importance of access problems for rural residents in obtaining a source of continuity of care. Similarly, of the three variables most strongly associated with lacking a regular source of ambulatory care due to financial problems, two (household income and level of education) were not associated with the global measure, regular source of ambulatory care.

This study has several limitations. Telephone surveys bypass the 5 percent to 10 percent of the population who do not have telephones, resulting in underrepresentation of the poor, elderly, and uninsured,[19–21] groups that are particularly at risk for access problems. Still, supplemental face-to-face interviews con-

TABLE 3—Odds Ratios for Lacking a Regular Source of Ambulatory Care (RSAC) Controlling for Other Factors in Logistic Regression Models (n = 5,748)

	Odds Ratio (95% Confidence Intervals)				
	No RSAC	No RSAC because of financial problems	No RSAC because of local resource inaccessibility	Did not want an RSAC	Transitory loss of RSAC
Age (yr)					
1–12	0.2 (0.1, 0.3)	0.6 (0.2, 1.8)	0.1 (0.1, 0.3)	0.1 (0.1, 0.2)	0.3 (0.1, 0.7)
13–22	0.8 (0.6, 1.1)	0.6 (0.2, 106)	1.2 (0.4, 3.6)	0.6 (0.4, 1.0)	0.9 (0.5, 1.6)
23–44	1.0	1.0	1.0	1.0	1.0
45–64	0.5 (0.4, 0.6)	0.6 (0.3, 1.4)	0.8 (0.4, 1.9)	0.5 (0.4, 0.7)	0.5 (0.3, 0.8)
≥65	0.4 (0.3, 0.6)	0.4 (0.1, 1.0)	0.9 (0.3, 2.3)	0.4 (0.3, 0.6)	0.3 (0.1, 0.6)
Health Status					
Excellent/Good	1.4 (1.1, 1.9)	1.9 (0.8, 4.6)	0.5 (0.2, 1.2)	1.5 (1.3, 2.2)	1.2 (0.6, 2.2)
Fair/Poor	1.0	1.0	1.0	1.0	1.0
Sex					
Female	1.0	1.0	1.0	1.0	1.0
Male	1.7 (1.4, 2.0)	1.8 (1.0, 3.3)	1.0 (0.5, 2.0)	1.8 (1.5, 2.3)	1.4 (1.0, 2.0)
Household Income*					
Poor	0.8 (0.6, 1.1)	5.2 (2.6, 10.6)	0.9 (0.2, 3.1)	0.6 (0.4, 1.0)	1.5 (0.8, 2.9)
Near-Poor	0.9 (0.7, 1.2)	1.8 (0.7, 4.3)	0.8 (0.2, 2.7)	1.2 (0.8, 1.7)	1.0 (0.5, 2.0)
Non-poor	1.0	1.0	1.0	1.0	1.0
Insurance Status					
Insured	1.0	1.0	1.0	1.0	1.0
Uninsured	2.0 (1.5, 2.7)	3.0 (1.5, 6.0)	0.7 (0.2, 3.1)	1.8 (1.3, 2.6)	1.8 (1.1, 3.2)
Race or Ethnicity					
Black/Hispanic	0.9 (0.7, 1.2)	0.7 (0.3, 1.5)	0.9 (0.3, 3.1)	1.3 (1.0, 1.8)	0.6 (0.3, 1.2)
White/Asian	1.0	1.0	1.0	1.0	1.0
Place of Residence					
Urban	1.0	1.0	1.0	1.0	1.0
Rural	1.0 (0.8, 1.2)	0.7 (0.4, 1.4)	5.8 (2.8, 11.9)	0.7 (0.6, 0.9)	1.3 (0.9, 1.9)
Education					
Non-High School Graduate	0.9 (0.7, 1.1)	2.5 (1.3, 4.8)	0.4 (0.1, 1.2)	1.2 (0.9, 1.7)	0.8 (0.4, 1.5)
High School Graduate†	1.0	1.0	1.0	1.0	1.0
College Graduate	0.8 (0.6, 1.1)	0.5 (0.2, 0.9)	1.3 (0.6, 2.8)	1.2 (0.9, 1.5)	1.7 (1.1, 2.5)

*Poor is defined as household income <100 percent of the federal poverty level, near-poor is 100–150 percent of the poverty level, and non-poor is more than 150 percent of this level.

†Includes those with some college.

TABLE 4—Receipt of Recommended Medical Care and Patient Satisfaction among Those with and without a Regular Source of Ambulatory Care (RSAC)

	Have an RSAC %	Do not have an RSAC %	Differences (95% CI)
Pap smear within the past year*	56	46	10 (3, 17)
Breast examination by physician within the past year†	59	31	28 (18,37)
Mammogram within the past year**	22	8	14 (5, 23)
Doctor visit for serious symptom during the past month††	66	42	24 (10,27)
Needed medical or surgical care during past year, but was unable to get it	7	12	–5 (–7,–3)
Completely satisfied with last doctor visit	85	75	10 (5, 14)

*For women 20 years or older.

†For women 40 years or older.

**For women 50 years or older.

††Percentage of those respondents who had 1) shortness of breath with light exercise/work; 2) exertional chest pain; 3) loss of consciousness; 4) abnormal bleeding; or 5) unexplained weight loss during the past month, and who saw or spoke to their doctor about it.

ducted in 1986 demonstrated, as others have found,[19–21] that inclusion of non-telephone households would affect percentage estimates only slightly. Nonetheless, small percentage differences in national surveys can represent millions of people. Furthermore, both survey techniques completely miss the homeless and those in institutions. In addition, the results are self-reported and are therefore dependent upon the reliability of respondents' recall. We are not able to determine whether population subgroups have different thresholds in reporting an access barrier. Also, 1.4 percent of respondents did not have a classifiable verbatim response. Although we found no pattern of one group being statistically more likely to have no available response, it may be that some of the weaker associations or trends might have been altered if responses had been complete. Finally, some of those who have a transitory loss of their regular source of ambulatory care or do not currently want one, may have unreported access barriers or may encounter access problems if and when they try to obtain one.

We conclude that most people who do not have a regular source of ambulatory care report that they do not want one, and the global measure, regular source of ambulatory care, fails to identify hose sociodemographic subgroups who are at greater risk of having barriers to obtaining a source of continuity of care. Therefore, if we are truly interested in who is at risk for access barriers to obtaining continuity of care, the reason for lacking a regular source of ambulatory care must be evaluated. □

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APPENDIX—Weighted and Unweighted Sample Size for Those with and without a Regular Source of Ambulatory Care (RSAC)

	Weighted Sample Size*	Unweighted Sample Size
Total Sample	2,626	5,748
Has an RSAC	2,196	4,904
No RSAC	430	844
Financial problem	(36)	(65)
Resource inaccessibility	(21)	(45)
Don't want an RSAC	(262)	(507)
Transitory loss of RSAC	(76)	(159)
Unclassifiable	(35)	(68)
Age		
1–12 years	517	821
13–22 years	402	591
23–44 years	931	1,985
45–64 years	468	1,318
≥65	308	1,010
Health Status		
Excellent/Good	2,285	4,833
Fair/Poor	335	887
Sex		
Male	1,267	2,404
Female	1,359	3,329
Household Income		
Poor	250	442
Near Poor	235	492
Non-poor	1,825	3,977
Race or Ethnicity		
Black/Hispanic	435	695
White/Asian	2,156	4,809
Place of Residence		
Urban	1,813	3,840
Rural	795	1,890
Education		
Non-High School Graduate	358	945
High School Graduate	1,337	2,873
College Graduate	552	1,130

*Represents a conservative estimate of the effective sample size after accounting for design effects.

A Community-Based Study of the Use of Chiropractic Services

Paul G. Shekelle, MD, MPH, and Robert H. Brook, MD, ScD

ABSTRACT

Background: Little population-based information is available on the use of chiropractic services.

Methods: We analyzed data from the RAND Health Insurance Experiment (HIE), a community-based study of the use of health services. Insurance claim forms for all fee-for-service patients who completed the study were examined for all visits coded as being seen by a chiropractor. Services provided and patient-specified symptoms were taken from these forms. Population-based use rates were calculated for each HIE site. Use rates and services were calculated separately for first visits and repeat visits.

Results: There were 5,279 persons who contributed 19,021 person-years of exposure during the study; 395 different persons used 7,873 chiropractic services for a visit rate of 41 per 100 person-years and rate of use of 7.5 percent. Forty-two percent of all visits were for pain in the back. Spinal manipulation accounted for 61 percent of all services provided. Compared to non-users, users tended to be White, middle-aged, married, and high school educated. Seven-fold geographic variations in the use of chiropractic services were seen.

Conclusions: Chiropractors deliver a substantial amount of health care to the US population, and there are significant geographic variations in the rate and intensity of use of chiropractic services. (*Am J Public Health* 1991;81:439–442)

Introduction

Previous studies of the use of chiropractic services have used patient samples that were obtained from selected chiropractors' offices or clinics.[1–8] Such studies have shown that chiropractic users are more likely to be middle-aged, employed, and high school educated. No difference in gender has been seen. Most studies have shown use among races in proportion to their representation in the population, but one study reported significantly greater use by Whites.[2] Low back pain is the most common complaint of patients seeking chiropractic care (from 32 percent to 45 percent, depending on the study), and spinal manipulation is the most frequently provided service (from 76 percent to 92 percent of all services). Population-based use rates cannot be estimated from these studies. Therefore, we analyzed data from a prospective, large-scale, community-based population to answer the following questions: How many people use chiropractic services? What are their demographic characteristics? For what symptoms do they seek care? What services are provided? Are there geographic variations in use?

Methods

The RAND Health Insurance Experiment was designed to assess how varying the patients' share of costs for health services affected their use of services, their satisfaction with health care, the quality of their care, and the state of their health. Eligibility, enrollment, data collection, and principal results have been reported elsewhere.[9]

In brief, the study was conducted between 1974 and 1982 at six sites: Seattle, Washington; Dayton, Ohio; Fitchburg, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown County, South Carolina. These sites were chosen to represent the four major census regions, both rural and urban areas, and differing levels of demand for health services. The population enrolled in the experiment, which was entirely civilian and under age 65, has been shown to be representative (across a wide range of variables) of the communities from which it was drawn and of the US population aged younger than 65.[10] Each enrollee was randomized to one of 14 fee-for-service insurance plans. All plans covered an identical wide range of services, including chiropractic care. Families were followed for three to five years.

Insurance claim forms of all fee-for-service patients who completed the study were examined for patient visits that had been coded as visits to a chiropractor. The symptoms we report here were the symptoms reported by the patients on their insurance claim forms as reasons for the visits. We took the services provided to be those for which reimbursement was sought by the chiropractor: visits, manipulations, X rays, laboratory tests, etc. Some patients and providers may have recorded more symptoms than others for equivalent conditions. We adjusted for this possibility in the following way. If multiple symptoms were recorded for a

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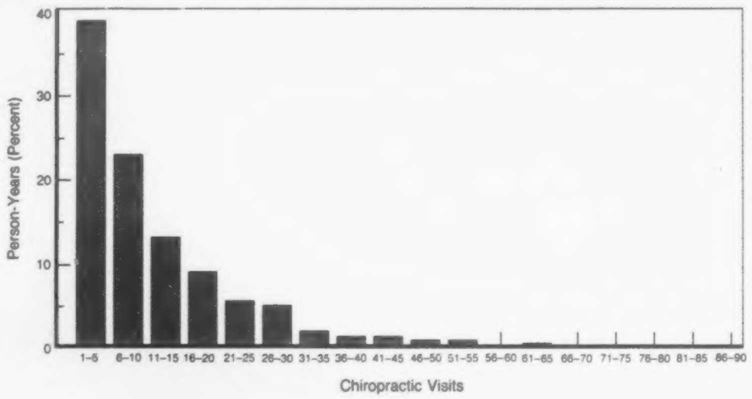

FIGURE 1—Number of Chiropractic Visits per Person-Year

TABLE 1—Comparison of Selected Demographic Characteristics of Chiropractic Users and Nonusers in the RAND Health Insurance Experiment

Characteristic	Chiropractic Users (%)	Nonusers (%)	Difference (95% Confidence Interval)
Male	49	48	1 (−4, 6)
White[a]	96	84	12 (9, 15)
Age			
<18	16	36	−20 (−24, −16)
18–50	70	50	20 (15, 25)
51+	14	13	1 (−3, 5)
Education[a]			
< High school	26	31	−5 (−10, 0)
High school graduate	47	36	11 (5, 17)
> High school	27	33	−6 (−11, −1)
Married[a]	74	45	29 (24, 34)
Working[a] (not homemaker)	67	64	3 (−2, 8)
Median family income[a] (1973 dollars)	$11,078	$11,192	114 (−666, 894)

[a] For adults age 18 or older.

single visit, each symptom was given a simple fractional weight so that for each visit the total symptom score summed to 1.0 (e.g., if two symptoms were recorded, each was given a weight of 0.5). Symptoms and services are presented here both as percentages and in terms of 100 person-years of exposure. A person-year was defined as a 12-month period beginning on date of enrollment (or anniversary date of enrollment) in the Health Insurance Experiment (i.e., not a calendar year). Population-based use rates were calculated for each Health Insurance Experiment site. Use rates and services provided were calculated separately for both the first patient visit and the repeat visits. First visits and repeat visits were defined by a specific code on the insurance claim forms to indicate whether the patient had seen this particular provider before. Because we could not calculate the number of visits on a per-episode basis, we calculated the number of chiropractic visits per person-year.

Results

The 5,279 people who completed the Health Insurance Experiment were enrolled for three or five years and represented a total of 19,021 person-years of exposure. During the study, 395 different persons (7.5 percent) made at least one visit to a chiropractor: 7,873 visits in all, or 41 chiropractic visits per 100 person-years. Repeat visits accounted for 82 percent of all visits. Only 1 percent of visits did not involve a face-to-face meeting between the patient and the chiropractor. Fewer than 1 percent of the visits were referred from another health care provider (either a physician or another chiropractor), seven percent of all visits were accident-related, and 1 percent were employment-related.

The 395 persons who saw chiropractors visited a chiropractor at least once during 683 person-years. In almost 40 percent of these person-years there were five or fewer chiropractic visits per year (Figure 1), and in 75 percent of them there were 15 or fewer visits per year. The median number of visits per year was seven and the mean was 11.5. In 13 person-years there were more than 50 visits per year, and these person-years contained 780 visits.

Table 1 compares the demographic characteristics of the chiropractic users with those of the nonusers. Chiropractic users were more likely to be White, aged 18–50, married, and high school graduates.

The most frequently given reason for a chiropractic visit (42 percent) was pain, swelling, or injury to the back region (Table 2). This symptom plus "back adjustment" accounted for 50 percent of visits overall, and this value varied from 41 percent to 69 percent, depending on the site.

Table 3 shows the services provided during the Health Insurance Experiment for the 395 chiropractic patients, by first visit and repeat visits. In the first chiropractic visit, manipulation (39 percent) accounted for the majority of services, but physical medicine visits (23 percent), office visits (19 percent), and X rays (17 percent) together accounted for almost 60 percent of the total services. Manipulation (66 percent) accounted for the majority of services provided for repeat visits, with physical medicine visits, office visits, and X rays accounting for 32 percent.

The frequency of chiropractic visits varied widely among the six Health Insurance Experiment sites (Table 4). The number of persons seeking care per 100 person-years ranged from 0.6 (Charleston) to 3.1 (Seattle). The number of services per 100 person-years on first visits and repeat visits varied from a low of 3.5 and 9.5, respectively, in Dayton and Charleston, to a high of 23.8 and 86.0, respectively, in Georgetown County, South Carolina.

Discussion

Our community-based study demonstrated a chiropractic visit rate of 41 per 100 person-years of exposure and that 7.5

TABLE 2—Patient-Specified Reasons for Chiropractic Visits

Reason for Visit[a]	Per 100 Person-years (N = 19,021 Person-years)	%
Pain, swelling, injury—back region	17.4	42.1
Pain, swelling, injury—face/neck	4.2	10.3
Headache	4.0	9.6
Back adjustment	3.4	8.2
Pain, swelling, injury—upper extremity	1.5	3.6
Pain, swelling, injury—lower extremity	1.2	2.8
Other symptoms referable to the digestive system	1.1	2.6
Progress visit, problem unspecified	1.0	2.3
Other examinations	1.0	2.2
General medical examination	0.8	1.8
Hip problems	0.6	1.4
Orthopedic foot problems	0.5	1.1
All others (75 different symptoms)	4.9	12.0
	41.6	100.0

[a]Includes all symptoms accounting for more than 1 percent of total visits.

TABLE 3—Services Provided by Chiropractors on First Visit and Repeat Visits per 100 Person-Years of Exposure

	First Visit		Repeat Visits	
Type of Service	Per 100 Person-years (N = 19,021 Person-years)	%	Per 100 Person-years (N = 19,021 Person-years)	%
Manipulation				
One area	4.1	38.9	25.8	66.1
Each additional area	<0.1	0.2	<0.1	0.2
Physical medicine visit	2.4	22.8	7.1	18.3
Various levels of office visit	2.1	19.3	4.2	10.7
Various X rays	1.8	16.8	1.2	3.2
Various laboratory tests	<0.1	1.0	0.2	0.5
All others	0.1	1.0	0.6	1.2
Total	4.2	100.0	45.5	100.0

percent of a community will use a chiropractor's service in a three- or five-year period. These numbers are somewhat lower than the 62 visits per 100 person-years and visit rate of 3.6 percent per year during the same time period that have been reported in the 1980 report to Congress on Manpower in the Chiropractic Profession.[4] Our study confirms previous observations that chiropractic users tend to be middle-aged and high school educated and that users do not differ from nonusers in their gender and income. We observed a greater use of chiropractic services by Whites, as also seen in one other survey.[2]

In previous studies, the average number of visits per user per year has varied between 5[6] and 18.[4] Our data, with a median of 7 and an average of 11.5, show that chiropractic use has a substantial tail to the right. In 13 person-years there were 50 or more visits per year. These 13 person-years (2 percent of the total person-years examined) contained 10 percent of the total number of visits. Results from the National Medical Ambulatory Care Survey between 1975 and 1980 showed that 7.7 visits per 100 person-years for back pain were made to physicians.[11] Our study showed that, during approximately the same time period, there were 17.4 visits per 100 person-years to chiropractors for the same complaint. Therefore chiropractors accounted for about twice as many visits for back pain as did physicians, as has been shown before.[12]

Symptoms of back pain accounted for 42 percent of patients visits. This finding is similar to 45 percent reported in Dade County, Florida;[5] 44 percent from Portland, Oregon[6]; and 32 percent from Tucson, Arizona.[8] This consistency from different geographic areas and time periods suggests that the symptoms for which patients seek chiropractic care vary little across the country.

Spinal manipulation, although still accounting for the majority of services provided, accounted for somewhat less than the 76 percent to 92 percent previously reported. In addition, there were differences in the types of services provided on the first visit and repeat visits. The typical first visit to a chiropractor appeared to consist of an office visit and/or physical medicine visit; most patients received an X ray and then manipulation. Repeat visits consisted of manipulation, with or without an additional office visit, and no further X rays. Because most chiropractic treatments involve a series of manipulations, it is not surprising that the number of manipulations far exceeded the number of office visits. As in previous studies, X rays and laboratory tests accounted for a relative minority of the total services.

First-visit use and repeat-visit use showed sevenfold and ninefold geographic variations, respectively, in chiropractic use in the Health Insurance Experiment. A previous study[4] had noted variations in chiropractic use, with greater use in the west and north-central regions of the US than in the South or Northeast. Our data cannot confirm these findings. In addition, Seattle and Charleston (both urban areas) had fourfold differences in use; Franklin County and Georgetown County (both rural) showed threefold differences in use. There was also substantial variation within a geographic area: the two southern sites exhibited the widest variation in use of chiropractic services.

The major limitations to this study are that its data are a decade old and that the elderly were excluded from the population. It has been estimated that the use of chiropractic services has been increasing during the past 20 years,[6] and the rate of use may be greater today than was seen in the RAND Health Insurance Experiment. A previous study of chiropractic use[2] reported that patients over age 65 accounted for 13 percent of the total number of chiropractic patients, and therefore we expect that excluding the elderly from our study will not qualitatively alter its conclusions. With these caveats, out study, because of its community-based design, provides an unbiased estimate of the use of chiropractic services, and documents that there are significant geographic vari-

TABLE 4—Use of Chiropractic Services for First Visit and Repeat Visits per 100 Person-Years, by Study Site

Site	Number Seeking Care per 100 Person-years	Services Used per 100 Person-years	
		First visit	Repeat visits
Dayton, OH	1.2	3.5	18.3
Seattle, WA	3.1	13.4	50.4
Fitchburg, MA	2.7	9.4	32.3
Franklin County, MA	1.9	7.1	30.5
Charleston, SC	0.6	5.7	9.5
Georgetown County, SC	2.8	23.8	86.0

ations in the rate and intensity of use of chiropractic services in the United States. ☐

Acknowledgments

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$7.5 Million Grant Program to Strengthen State Data Systems

The Robert Wood Johnson Foundation recently announced a $7.5 million grant program to be made available to state policy-makers to provide them with more accurate, up-to-date data about health care issues.

In the first phase of the program, up to 10 states will be awarded grants of up to $150,000 each to identify gaps in health policy and program information, and then to develop plans to fill them. Grant project directors will review information needs and set priorities, establish short- and long-term plans, and develop a specific proposal for enhancing existing data systems or for creating new ones to meet high priority information needs.

Each grant will be carried out by a lead government agency designated by the governor, and a working group composed of analysts from other state agencies, the legislature, state health program managers, health data agency representatives, private sector organizations, consumer groups, and others.

Based on the strength of the plans developed during the 18-month grant period, the RWJ Foundation will award as many as six four-year grants for amounts up to $1 million each; these grants will be used to develop and test the planned data system improvements, for data collection, analysis and dissemination.

The deadline for submitting proposals is August 1, 1991. Grant applicants must be state government agencies. An information conference for potential applicants is scheduled for May 1991.

Agencies wishing to apply for funds should contact: Ann P. Pomphrey, Program Assistant, Robert Wood Johnson Foundation, Route 1 and College Road East, P.O. Box 2316, Princeton, NJ 08543-2316. Technical assistance to the program will be provided by Ruth S. Hanft, PhD, research professor, Department of Health Services Management and Policy, George Washington University, Washington, DC.

Morbidity and Disability in Older Persons in the Years Prior to Death

37

ABSTRACT

Background: A large proportion of the disease and disability which affects older persons occurs in the years just prior to death. Little prospective evidence is available which quantifies the burden of morbidity and disability during these years.

Methods: In three community-based cohorts of persons age 65 and older, chronic conditions and disability were evaluated for the three years prior to death in 531 persons who had three annual assessments and then died within one year of the third assessment. Number of chronic conditions, prevalence of disability in activities of daily living (ADLs), and prevalence of disability on a modified Rosow-Breslau scale were determined for these decedents and compared to 8821 members of the cohorts known to have survived.

Results: Prevalence rates of disease and disability increased during the follow-up for both decedents and survivors, with decedents generally having higher rates than survivors. Disability rates prior to death, but not the number of diseases, increased with increasing age at death. The odds ratio for disability in ADLs at any of the three assessments for decedents versus survivors ranged from 3.0 to 4.2 in the three communities. In each community the odds ratio for ADL disability was higher in women decedents versus survivors than in men decedents versus survivors.

Conclusions: These results have important implications for disability levels in future older populations in which death is projected to occur at increasingly higher ages. (*Am J Public Health* 1991;81:443–447)

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Introduction

Prior to death, there is a decline in health status which may be quite variable. For the individual with a severe stroke who remains in a nursing home for several years, the state of poor health prior to death may be prolonged; for the person with metastatic cancer dying six months after diagnosis, duration of disability is moderate; and for the previously healthy individual who suffers sudden death, the state of poor health is virtually nonexistent. Just as the duration of poor health prior to death may be quite variable, its severity may also vary considerably. Increases in morbidity and disability prior to death have tremendous impact on individuals, their families, and the health care delivery system. With 71 percent of all deaths in the United States occurring among people age 65 and older,[1] it is of value to describe the systematic decreases in health status prior to death in this population.

The rising costs of caring for the older population have lead to a great deal of interest in the utilization and cost of health care in the years prior to death.[2] A study using Medicare data showed that 28 percent of all Medicare costs were incurred by the 6 percent of enrollees who would die within the next 12 months.[3] A study using data from the province of Manitoba was able to capture nearly all health care utilization in the years prior to death and found substantial increases in several measures of utilization with increasing proximity to death.[4]

Limitations are inherent in the use of health care utilization data to measure health status prior to death. Direct measures of disease and disability in older persons provide a more accurate description. There are a limited number of studies which examine disease or disability prior to death using either retrospective reporting of proxies[5,6] or prospective study designs.[7,8] In the present study, three representative populations of older persons were prospectively evaluated using self-report of common chronic diseases and two scales of physical functioning. The objectives of this analysis were to quantify the prevalence rates of disease and disability as death approached, compare these prevalence rates among decedents to rates in surviving members of the cohort, and examine how this process varies by gender and age at death. It was further hypothesized that disease and disability rates would increase to a greater extent in decedents than in survivors during the period of observation.

Methods

Study Populations

The data for these analyses are from the Established Populations for Epidemiologic Studies of the Elderly (EPESE),

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TABLE 1—Number of EPESE Participants Surviving to Follow-up 3 and Dying between Follow-ups 2 and 3 by Site, Age Group, and Sex

Site and Age Group (years)	Survived to Follow-up 3		Died between Follow-ups 2 & 3	
	Men	Women	Men	Women
East Boston				
65–74	814	1333	46	37
75–84	314	583	30	47
85+	79	145	17	27
Total	1207	2061	93	111
Iowa				
65–74	746	1089	32	23
75–84	363	787	43	27
85+	80	181	12	21
Total	1189	2057	87	71
New Haven				
65–74	569	806	37	29
75–84	271	483	30	40
85+	49	129	16	17
Total	889	1418	83	86
Total All Sites	3285	5536	263	268

longitudinal studies of persons aged 65 and older. Participants included in these analyses were enumerated and interviewed in three communities in 1982 and early 1983. Details of study design and sampling strategies have been reported elsewhere.[9,10] Briefly, in East Boston, Massachusetts, and Iowa and Washington Counties, Iowa, full community surveys were conducted. A baseline response rate of 84 percent yielded 3,812 participants in East Boston, and in Iowa an 80 percent response rate yielded 3,673 participants. The New Haven target population was a stratified cluster sample of 3,420 eligible persons age 65 and older, drawn from three types of community dwellings: public elderly housing, where age and income are restricted; private elderly housing, where age is restricted; and private apartments and houses. There was oversampling of men and those living in elderly housing. A baseline response rate of 82 percent yielded 2,812 participants.

For the sake of clarity in understanding change in functional status and disease prior to death, these analyses were limited to a subset of participants for whom interview information was available for three consecutive years. The subjects of these analyses are those respondents from the three sites who participated in the baseline and first and second annual follow-up interviews and whose vital status was known for the next year of follow-up. Participants who died any time before the second annual follow-up were excluded from these analyses. Ascertainment of vital status at the end of the third follow-up year was nearly 100 percent at all sites.

Data Collection

The baseline interview was conducted in participants' homes and the first and second annual follow-up interviews were conducted by telephone or, if this was not possible, in person. A proxy interview was conducted for those unable to participate in the interview. Chronic conditions were assessed by asking respondents at baseline if they had ever been told by a doctor that they had a heart attack, stroke, cancer, diabetes, or hip fracture. At each follow-up interview, respondents were asked if they had been told by a doctor since the last interview that they had any of these conditions. Disability in activities of daily living (ADLs) was defined as self- or proxy-report of needing help from a person or special equipment in performing one or more of the following activities: walking across a small room, bathing, grooming, dressing, eating, transferring from bed to chair, or using the toilet.[11,12] Disability on a modified Rosow-Breslau scale of physical functioning was defined as the need for help in performing one or more of the following tasks: walking up and down stairs to the second floor, walking one-half mile, and doing heavy housework.[13] ADLs and Rosow-Breslau items were assessed at baseline and each annual follow-up.

Analytic Methods

Mean number of self-reported chronic conditions and prevalence of disability at baseline and at the first and second follow-ups were calculated separately for those dying in the one year period between follow-up 2 and follow-up 3 and for those surviving to follow-up three. The number of chronic conditions at each follow-up was calculated by determining the lifetime prevalence of each condition, taking into account baseline report as well as annual follow-up report of the occurrence of the condition in the previous year or years. Therefore, the number of chronic conditions for an individual could only stay the same or increase during the follow-up period. Individual reports of disability at each assessment were independent of other assessments.

Multiple logistic regression models were used to assess the odds of being disabled in any of the first three interviews for those dying between the second and third follow-ups compared to those surviving to follow-up 3.

Results

Table 1 shows the number of study participants who survived to follow-up 3 and who died between follow-ups 2 and 3 according to community, age group, and sex. There were 531 decedents and 8821 survivors in the communities by this definition. Those dying prior to follow-up 2 are not included in these numbers or in subsequent analyses.

In Figures 1, 2, and 3, the mean number of chronic conditions, the percent disabled in ADLs, and the percent disabled in Rosow-Breslau items and are shown for those dying between follow-ups 2 and 3 and those surviving to follow-up 3. Results are shown for baseline, follow-up 1 and follow-up 2 and are presented separately for each site, sex, and age group. For those dying between follow-up 2 and 3, the baseline data reflect morbidity and disability status from two to three years prior to death, the follow-up 1 data reflect status between one and two years prior to death, and the follow-up 2 data reflect status between zero and one year prior to death.

For nearly every site, sex, and age subgroup, the mean number of conditions and the proportion disabled was higher in those destined to die than in survivors. In most subgroups, these differences are evident even at baseline, which is two to three years prior to decedents' deaths. In general, mean number of conditions and disability prevalence rates increased as death approached. For those surviving to follow-up 3, there was also, for most subgroups, an increase in chronic conditions and disability from the baseline through the second follow-up interview. For some subgroups, the slope of the increase in de-

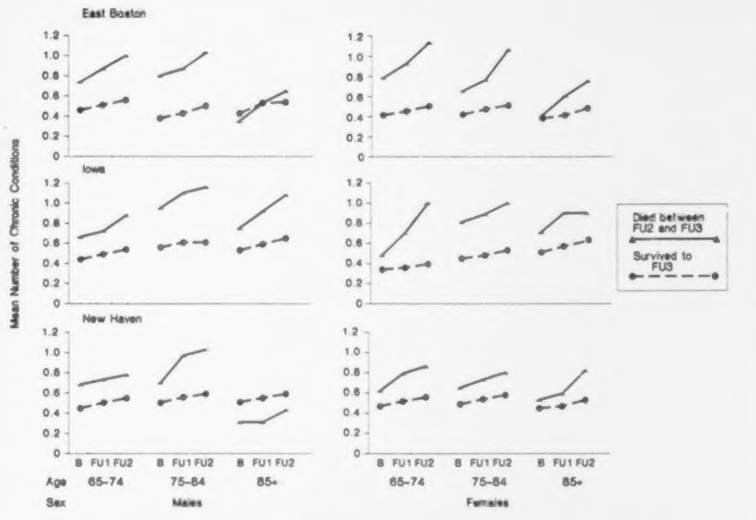

FIGURE 1—Mean Number of Chronic Conditions at Baseline, Follow-up 1 and Follow-up 2 According to Survival Status between Follow-up 2 and 3, Age Group and Sex; EPESE

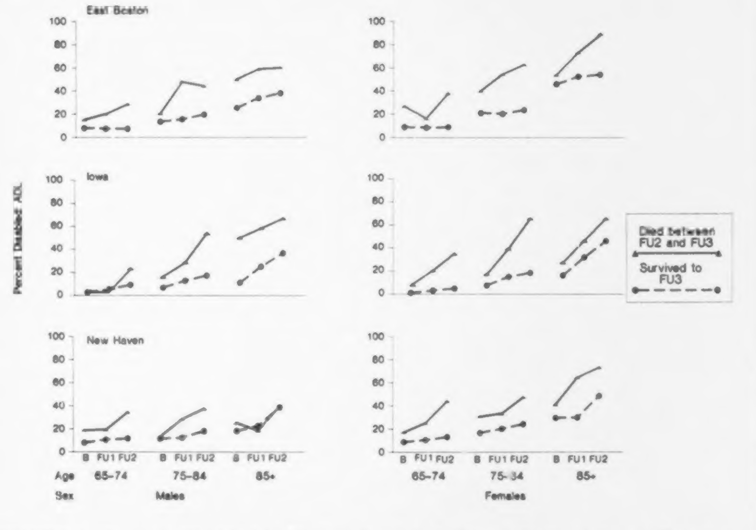

FIGURE 2—Percent Disabled in One or More Activities of Daily Living at Baseline, Follow-up 1 and Follow-up 2 According to Survival Status between Follow-up 2 and 3, Age Group and Sex; EPESE

cedents was clearly steeper than for the survivors, although this was not the case in all subgroups. In general, smaller differences were seen between decedents and survivors in the age group 85 years and older than for the two younger age groups.

Disability rates as measured by ADLs generally showed a substantial increase as death approached and were higher with increased age at death. In decedents aged 65–74 and 75–84 years at baseline, only about one-fourth or less report ADL disability at baseline, which was from two to three years prior to their deaths. At follow-up 2, within one year of death, the 65–74-year-old group had, in general, an ADL disability prevalence rate of 40 percent or less. In the 75–84-year-old group of decedents, up to two-thirds were disabled in ADLs in the year prior to death. Decedents aged 85 and older at baseline had the highest rates of ADL disability in the year prior to death (between 60 and 90 percent), with the exception of New Haven men.

Disability rates as assessed by the Rosow-Breslau items were higher in both decedents and survivors than corresponding rates of ADL disability. In the year prior to death, prevalence rates of disability, as measured by the Rosow-Breslau scale, were over 60 percent in nearly all subgroups, with those 85 and older having prevalence rates in excess of 80 percent. An increase in Rosow-Breslau disability rates with increased age at death was evident in most subgroups. Unlike disability measured by both instruments used here, mean number of chronic conditions prior to death did not show a consistent increase with age at death.

Table 2 demonstrates the magnitude of the differences in disability in ADLs in the baseline and first two follow-up interviews between those dying and those surviving. Odds ratios are presented for disability in any of these interviews for decedents compared to survivors. Overall, decedents were about three to four times as likely as survivors to report an ADL disability in either the baseline or first two follow-ups, after adjusting for age and sex. In men, decedents were 2.4 to 3.7 times as likely as survivors to report ADL disability. In women, the odds of disability in decedents was 3.7 to 5.2 times that of survivors. In each site, the odds ratio for disability for women who died versus survived was higher than the odds ratio for disability for men who died versus survived. The odds ratios for disability in decedents versus survivors by age group reveal no consistent trends with age across the three communities.

Discussion

Although the prevalence rates of disease and disability increase with age, there is no *a priori* reason to believe that within older populations those dying at a younger age should have less disability prior to death than those dying at older ages. These data reveal that those dying at the oldest ages generally have more disability, but not disease, prior to death than those dying at younger ages. As expected, the rates of disease and disability rise as death approaches, and those destined to die

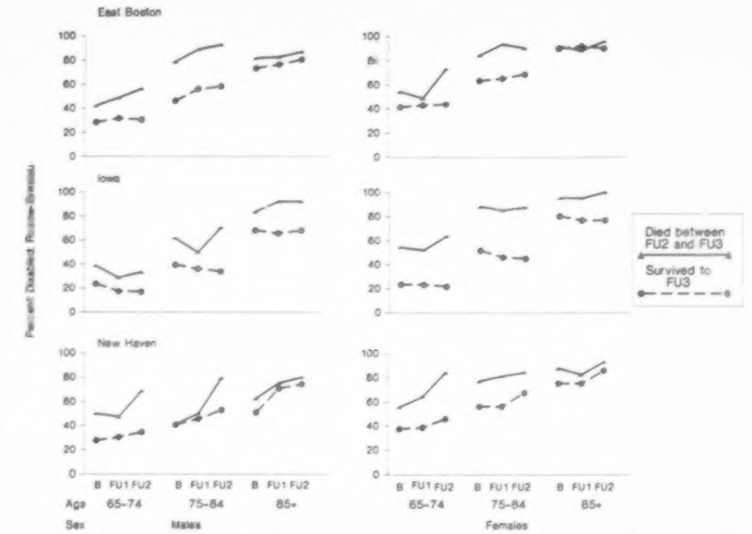

FIGURE 3—Percent Disabled in One or More Rosow-Breslau Items at Baseline, Follow-up 1 and Follow-up 2 According to Survival Status between Follow-up 2 and 3, Age Group and Sex; EPESE

have higher disease and disability rates than those of the same sex and age who survive.

In the conceptualization of these analyses, it was speculated that it might be possible to elucidate an even more refined relationship of morbidity and disability with death than we were able to demonstrate here. Consistent patterns were sought for differences in morbidity and disability during the three years of observation in decedents compared to survivors. Alternative patterns were postulated, including both groups starting out at the same disease or disability level and then diverging, the two groups starting out at different levels but remaining parallel, and the two groups starting out at different levels but still diverging during the years of observation. None of these patterns were observed in any consistent manner (Figures 1–3). This may be the result of methodologic shortcomings of this study or may reflect true variability in these relationships among different age groups, men and women, and the communities under study. A summary measure of ADL disability, that is, having any ADL disability in the three years prior to death, was employed to further investigate differences in sex and age relationships comparing decedents and survivors (Table 2). The odds of disability in decedents versus survivors showed no clear trend with age, but in each community the odds ratios for disability comparing decedents to survivors were higher in women than men.

A number of methodologic limitations must be considered in the interpretation of these results. The results in Figures 1–3 summarize percent disabled and mean number of conditions in a subgroup at a particular point in time, but changes for particular individuals as they approach death could differ considerably from these summary measures. It has been documented that change in functioning over time in individuals can be quite variable, with some reporting improvement, some reporting decline, and some reporting no change.[12,14] Research is now underway to analyze the multiple patterns of change which result from the repeated measures obtained in these longitudinal studies. These populations were all community-dwelling at baseline, although follow-up was completed for those entering an institution in subsequent years. Because rates of institutionalization increase dramatically with age, it is likely that the age gradient seen in disease and disability prior to death would be even steeper if all those in nursing homes three years prior to the deaths were included in the study. Although the cohorts under study are large, the number of deaths per year is not great and stratifying these deaths by age group and sex results in small sample sizes for certain subgroups. Larger numbers of deaths would have resulted in more accurate estimates of disease and disability prior to death and led to smoother curves for decedents in Figures 1, 2, and 3. The measures available to define morbidity and disability were fairly crude. The list of five chronic diseases was not comprehensive, being limited to those conditions queried at each interview. Disability status as estimated by both scales used here was dichotomized for ease of understanding and presentation. More refined scales, or perhaps the use of other measures which may be more sensitive to change over time, could lead to a finer understanding of the relationships investigated in this study. Finally, in comparing decedents to survivors there may be a "ceiling effect" which obscures the magnitude of differences in these two groups. This is seen, for instance, for the Rosow-Breslau scale for those aged 85 and older, in whom

TABLE 2—Odds Ratios (95% confidence intervals) for Reporting Disability in Activities of Daily Living at Any Interview (Baseline, Follow-up 1, or Follow-up 2) for Those Dying between Follow-up 2 and Follow-up 3 Compared to Those Surviving to Follow-up 3

	East Boston	Iowa	New Haven
Total Population*	4.0 (2.9, 5.6)	4.2 (3.0, 6.1)	3.0 (2.1, 4.2)
Men**	3.6 (2.2, 5.8)	3.7 (2.3, 6.0)	2.4 (1.5, 3.9)
Women**	4.4 (2.8, 6.9)	5.2 (3.0, 9.0)	3.7 (2.3, 6.1)
Age 65–74***	3.7 (2.3, 5.9)	3.3 (1.8, 6.1)	3.3 (1.9, 5.5)
75–84***	4.4 (2.5, 7.5)	5.5 (3.2, 9.5)	3.3 (2.4, 4.6)
85+***	4.4 (1.6, 11.8)	3.7 (1.5, 9.0)	1.9 (0.8, 4.2)

*Adjusted for sex and age.
**Adjusted for age.
***Adjusted for sex and age within 10 year age group.

the level of disability in survivors is so high that there may be little room for the decedents to appear more disabled (Figure 3).

There have been few prospective studies which have evaluated changes in disease and functional status prior to death. A number of studies have addressed terminal drop or terminal decline, but nearly all have focused on psychosocial or cognitive factors.[7] In a study which assessed declines in a number of domains, Palmore and Cleveland examined both terminal decline (defined as a steady, linear decrease prior to death) and terminal drop (defined as an accelerated decrease as death approaches) in 178 decedents in the Duke Longitudinal Study of Aging.[7] In a multivariate model, they found significant associations of both age and number of months prior to death with physical functioning. These results are in agreement with the findings presented here, as they can be interpreted to mean that, controlling for age at exam, there is decreasing physical functioning with increasing proximity to death, and, controlling for proximity to death, there is decreasing physical functioning with increasing age. They found no evidence of terminal drop.

Deeg and colleagues analyzed data for 88 residents of a home for the elderly in the Netherlands for whom four assessments were available in the year prior to death.[8] Declines were observed in physical, cognitive, and social functioning and morale as death was approached, and decedents had poorer scores in these domains than survivors. Model fitting revealed statistical evidence of an accelerated decline, or terminal drop, in physical functioning during this last year of life. In contrast to the present study, no age differences were found in physical functioning prior to death when comparing those younger than age 80 and those aged 80 and older. In another small study, there was no clear age gradient in the proportion of those judged clinically to be fully functional at 12 months, 6 months and 1 week before death.[15] These results suggest that there may be no age gradient in disability in the final year of life, but that this gradient may be present in the several years prior to death, as shown in this study. More research is necessary to answer this question definitively.

The current study has important implications for the older population now and in the future. Irrespective of the age at which an older individual dies, it is likely that a large proportion of the total years spent in the disabled state will be contributed by the years just prior to death. As the total population ages, preventive interventions, whether initiated at young or older ages, must have the ultimate goal of not only increasing longevity but of reducing disability. Any prevention efforts, at whatever age, to reduce total number of disabled person-years must address the issue of morbidity and disability prior to death, making this an important area for continued investigation. This study revealed that women decedents had proportionately higher rates of disability prior to death than men when compared to same-sex survivors, even after controlling for differences in age at death. This is important in an aging population in which, at each higher age, the female:male ratio increases and in which women have higher overall rates of disability than men.

Finally, the findings that the highest disability rates prior to death were found to be associated with death at the oldest ages can have grave implications for the total population burden of morbidity and disability in future years. If, as projected, life expectancy continues to increase,[16] the proportion of persons dying at the oldest ages will also increase. The total number of person-years of disability prior to death would thus increase, assuming age-specific rates of disability prior to death remain unchanged. Increased disability prior to death in future older populations, in which a large proportion of deaths will occur at the oldest ages, could make the quest for an overall compression of morbidity in the older population difficult, if not impossible. ☐

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The Yield of Cholesterol Screening in an Urban Black Community

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ABSTRACT

Background: While the distribution of cholesterol levels have been well studied in the general population, little is known about cholesterol and other cardiovascular disease risk factors in screenings held in an urban Black community. This study was designed to determine the yield of cholesterol screening in this community.

Methods: Screening took place in eight community sites. Serum total cholesterol was measured using a rapid capillary technique. Blood pressure was taken according to national guidelines and the average of two to three measurements were used. Standard interviews were used to determine the presence of cardiovascular risk factors by history.

Results: Of the 562 individuals screened, 44.9 percent had cholesterol levels requiring referral for follow-up care. Of those with total cholesterol ≥6.21 mmol/L, 66.4 percent were previously undetected and more than half also had blood pressure levels ≥140/90 mmHg on screening; 45 percent of all participants had blood pressure ≥140/90 on screenings. Of those with a history of elevated total cholesterol levels, none had levels below 5.17 mmol/L at the time of screening.

Conclusions: Multiple risk factors are highly prevalent in the urban Black community during cholesterol screening programs. Findings suggest the need for cholesterol programs incorporating blood pressure screening in the urban Black community. (*Am J Public Health* 1991; 81:448–451)

Introduction

Recommendations by the National Cholesterol Education Program (NCEP) and the availability of portable rapid cholesterol analyzers have facilitated the implementation of population-based mass cholesterol screening programs.[1–6] Recent studies indicate that Blacks are less likely than Whites to participate in voluntary mass screening programs, often held in integrated shopping malls or work sites.[7] Little is known about blood cholesterol patterns or the potential yield of cholesterol screening programs targeted specifically to an urban Black population in settings that minimize volunteer-bias. This is of particular importance to public health given that cardiovascular disease and stroke remain the leading causes of morbidity and mortality in the Black population.[8,9]

This study was designed to determine the yield of cholesterol screening and the prevalence of other coronary heart disease (CHD) risk factors in an urban Black population in East Baltimore.

Methods

Data were obtained from the first six months (June 1988 through November 1988) of the East Baltimore Community Heart Disease Prevention Project, a free collaborative cardiovascular risk screening and education program conducted by The Johns Hopkins Hospital, the churches in East Baltimore, and the community Mayor's Stations. The program is available to 71,292 residents in the 21 census tracts constituting East Baltimore.[10] Residing in these census tracts are 47,438 adults ≥21 years of age; 88 percent are Black; 53 percent are female; the median age is 20.5 years; 57 percent are high school graduates; 46 percent have income levels below the poverty limit; 30 percent of eligible adults are unemployed.[10]

Screening sites included five churches, one public housing project, and two major grocery markets in the catchment area. Screening was concentrated in churches, as 68 percent of Blacks in East Baltimore are reported to be active members of a church.[10] To minimize bias that may be associated with purely voluntary attendance at sites dedicated solely to screening, church screenings took place in concert with high attendance Sunday services, while screenings in grocery stores concentrated on Friday evenings and Saturday mornings.

Serum total cholesterol (TC) was measured using a rapid capillary (fingerstick) method and the Reflotron technology (Boeringer-Mannheim, Indianapolis). Participants were not fasting. Standard procedures for quality control recommended by the Laboratory Standardization Panel of the NCEP were followed at each screening site.[11] In a recent companion study of over 9,000 screening participants using the same cholesterol screening technology and personnel used in this study, this method was 95 percent sensitive for identifying TC levels ≥5.17

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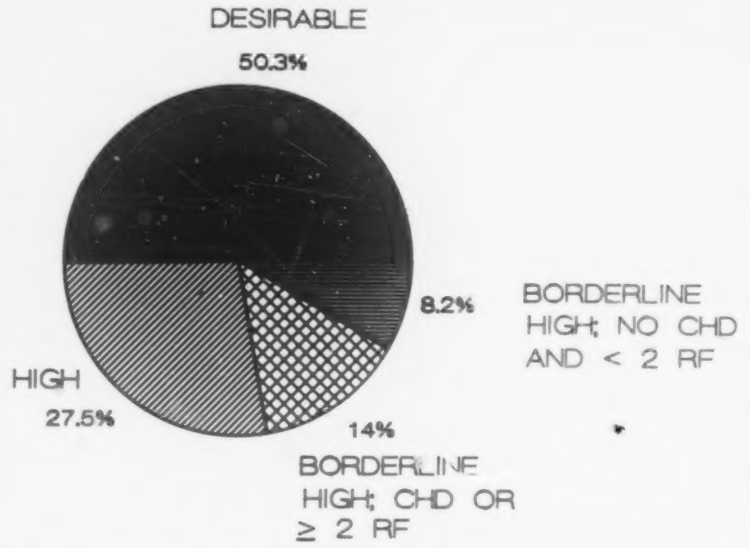

FIGURE 1—Overall Total Cholesterol Distribution according to National Cholesterol Education Program Adult Treatment Guidelines in Males (N = 186)

Borderline high = 5.17 to 6.18 mmol/L (200–239 mg/dl).
High = ≥6.21 mmol/L (240 mg/dl).
CHD = coronary heat disease.
RF = self-reported risk factors.

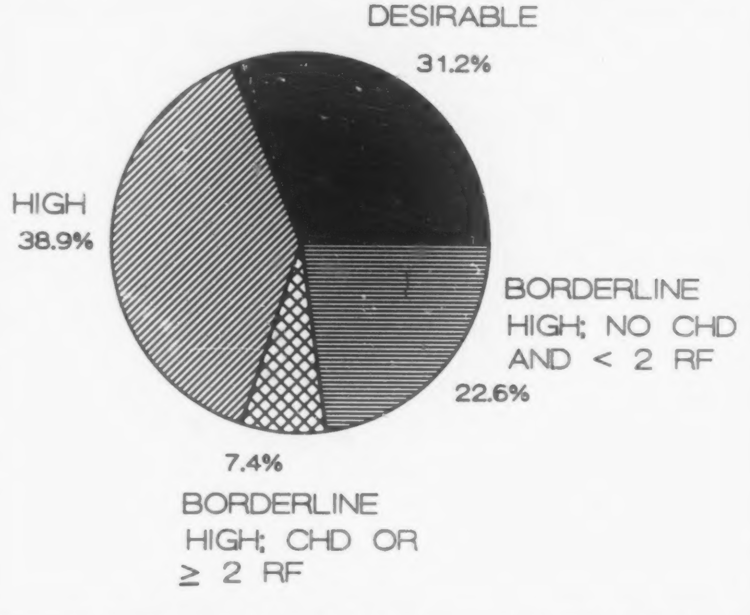

FIGURE 2—Overall Total Cholesterol Distribution according to National Cholesterol Education Program Adult Treatment Guidelines in Females (N = 366)

Borderline high = 5.17 to 6.18 mmol/L (200–239 mg/dl).
High = ≥6.21 mmol/L (240 mg/dl).
CHD = coronary heat disease.
RF = self-reported risk factors.

mmol/L (200 mg/dl), with the Johns Hopkins Lipid Research Clinics Laboratory method serving as the reference standard.[12]

Blood pressure measurements were taken with a mercury sphygmomanometer according to guidelines of the Joint Committee on High Blood Pressure IV (JNC IV).[13] The average of two measurements was used to characterize blood pressure during the screening for individuals with initial levels ≤120/80 mmHg; the average of three measurements was used for initial levels >120/80 mmHg.

Standardized personal interviews were conducted to determine the presence of CHD risk factors cited by the NCEP Adult Treatment Guidelines as factors that may lower the referral and treatment threshold for elevated cholesterol levels. Self-reported data were collected on age, height, body weight, smoking status, family history of premature CHD, medication use, and personal medical history of high cholesterol, hypertension, diabetes mellitus, CHD, and stroke. History of peripheral vascular disease proved difficult to assess by interview alone and was therefore not used. Accurate smoking history also proved difficult to obtain in the church setting, as many participating churches have explicit religious sanctions against smoking.

Results

The total number screened was 562; all were Black; the mean age was 50 ± 14.5 years for males and 51 ± 13.4 years for females; 66.7 percent were female; 11.8 percent had a personal history of CHD or stroke, and 10 percent had a history of diabetes. The mean TC was 5.35 ± 1.4[illegible] mmol/L for males and 5.86 ± 1.343 mmol/L for females. Among males, 41.5 percent had TC levels in the NCEP "high" and "borderline high" range with known CHD or two or more known risk factors (Figure 1). Among females, a total of 46.3 percent had TC levels classified as "high" and "borderline high" with existing CHD or two or more known risk factors (Figure 2). Thus, a total of 44.9 percent of all screening participants required referral to the medical care system for follow-up screening according to NCEP guidelines.

Data were also collected on prior awareness of cholesterol levels in 393 screening participants. The interview item on awareness was inadvertently omitted from printed instruments administered to the first 169 screenees, who did not differ

TABLE 1—Logistic Regression Analysis: Predictors of Total Cholesterol ≥6.21 mmol/L (N = 592)

Variable	Relative Odds	95% Confidence Interval:Odds
History of CHD or Stroke	1.17	1.01–1.35
Hypertension*	1.12	1.02–1.22
Female Gender	1.09	0.98–1.20
Age ≥60 years	1.05	0.38–1.15
History of Diabetes	1.03	0.90–1.18

*Hypertension = Blood pressure ≥140 mmHg or self-reported history of hypertension.

clinically or statistically in age, gender, TC levels, or co-morbidity from the next 393 participants. Of the 393 participants on whom the data were obtained, 56.3 percent reported never having had cholesterol levels checked before the screening. Of the 113 people identified as having TC levels ≥6.21 mmol/L on screening, 75 (66.4 percent) were not aware of high levels prior to the screening. More men (72 percent) than women (64 percent) were unaware of having elevated TC levels. Of those who reported having a known "high" TC level, 37 percent (23/61) had levels below 6.21 mmol/L at the time of this screening, but none were below 5.17 mmol/L; five people were taking a lipid-lowering medication.

More than half (54 percent) of those with TC levels ≥6.21 mmol/L also had hypertension, usually detected by screening rather than by history alone; 45 percent of screenees had blood pressure levels ≥140/90 mmHg on screening.

Logistic regression analysis was used to determine the relative importance of female gender, age ≥60 years, existing diabetes, a history of CHD or stroke, and the presence of hypertension in predicting "high" TC levels, ≥6.21 mmol/L (Table 1). Past history of CHD or stroke and hypertension, either by history or on screening, were the only principal independent predictors of having a "high" TC level. As body mass index (BMI) was calculated for only 126 participants, primarily because many individuals were reluctant to report weight or to be weighed in the mass screening setting, or did not know their height, this was not included in the overall regression analysis.

Discussion

Most prior screening studies conducted primarily in health care settings, work sites, and shopping centers in predominately White populations with a similar age distribution have yielded smaller percentages with NCEP "high" TC levels, generally in the 23 to 27 percent range[2,3,5,14] in contrast to the 35 percent found in the urban Black population in this study. However, in the second National Health and Nutrition Examination Survey (NHANES II) of a national probability sample of the civilian noninstitutionalized US population, a smaller percentage of Blacks (24 percent) were found to have NCEP "high" TC levels.[15] Furthermore, Whites were found to be more likely to have "high" or "borderline high" TC levels. This seeming discrepancy between the NHANES data and results of our study may be explained by the probable lower socioeconomic distribution of the community represented here.

Potential biases in the ascertainment of TC levels and subsequent NCEP classification may have resulted in underestimating the number of screening participants requiring referral to the medical care system. Specifically, we were unable to obtain accurate information for all individuals on smoking, obesity, and peripheral vascular disease in the screening settings. It is possible that larger numbers of individuals with "borderline high" TC levels had two or more NCEP-defined cardiovascular risk factors; this would place them at higher CHD risk and result in a medical care referral. Conversely, other biases in the sample may have resulted in overestimating the numbers requiring referral. Namely, women were differentially represented among participants. False positive misclassification bias may potentially have occurred in the studied population because women and Blacks are known to have higher levels of high density lipoprotein cholesterol, the lipoprotein subfraction that is potentially protective and that contributes to the total cholesterol level.[16] This potential source of bias may exist in this study as more women than men had "high" TC levels and slightly more women than men had levels that required referral to the medical care system according to NCEP Guidelines.

The association between hypertension and high cholesterol levels found in this study has also been reported recently in other population-based studies in Whites.[17] This link is of particular concern in the Black community given the known high prevalence of hypertension. Although the mechanism of this clustering of high cholesterol levels and high levels of blood pressure is not clear, replications of this finding suggest that the coexistence is not coincidental. The confluence of older age, diabetes, obesity, high sodium and fat diets, and sedentary life-style in urban Blacks may be important in the development of both hypertension and hypercholesterolemia.

This study, perhaps because of the nature of its venues, showed that women and older people were more likely to come to be screened. Cholesterol screening targeted specifically to Blacks in East Baltimore yielded a large number of people with previously undetected high cholesterol levels as well as large numbers of people with co-existing hypertension and hypercholesterolemia. These findings suggest the need for screening programs that address multiple rather than single risk factors in the Black community. Outreach strategies that extend beyond churches and food stores may be required to access men and younger people in urban Black community settings. In order to fulfill their ultimate mission to lower cardiovascular disease risk, cholesterol screening programs may need to focus strongly on the provision of health care follow-up, given the known dearth of chronic disease prevention services in inner-city Black communities.[18] Further, Blacks are known to utilize the health care system in unique ways that do not enable implementation of traditional health education or health promotion efforts.[19,20] Investigations of innovative programs that offer intensified on-site diet counseling and that provide at least first-stage verification of initial elevations of cholesterol may assist in diminishing referrals to the overburdened medical care systems in these communities.[19] □

Acknowledgments

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Appreciation is expressed to Elizabeth Ward of the Dunbar Mayor's Station and to CURE (Clergy United for Renewal of East Baltimore) for consultation and assistance in implementing this project.

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Call for Papers on Quality of Nursing Life: Taking Charge of Change

The Alberta Hospital Association, in cooperation with a number of nursing service, nursing education, professional, paraprofessional, employer, and labor organizations is sponsoring its second biannual forum in February 1992.

Quality Of Nursing Life: Taking Charge of Change is the theme of the forum to be held in Calgary, Alberta, Canada, February 5–7. The focus of the forum is to share innovative ideas for taking a leadership role in changes in health care.

Papers are being sought that present proven innovative ideas related to advancing positive change, including participation in decision making, dealing with the impact of economics, professional responsibility and ethics, promoting wellness for nurses, innovations in education, living with new information systems, promoting professional pride, or expanding roles of nurses.

A package providing details of abstract requirements is available from Education Services, Alberta Hospital Association, 10009-108 Street, Edmonton, Alberta, Canada T5J 3C5; (403) 498-8403, FAX (403) 498-8465. Deadline for receipt of abstracts is May 1.

Alcohol Drinking Patterns and Blood Pressure

ABSTRACT

Background: Although blood pressure tends to increase with average alcohol consumption, little is known about the effects of drinking patterns on blood pressure. Therefore, the effects of average drinks per day and drinking pattern (defined as the independent and interactive effects of quantity and frequency) on blood pressure were compared.

Methods: Data were obtained from a random sample survey of 1,635 household residents in Erie County, New York. Alcohol-blood pressure relationships were examined using multiple regression analyses that controlled for the potentially confounding influence of 13 additional risk factors for elevated blood pressure.

Results: Consistent with prior research, a positive relationship was found between average drinks per day and diastolic and systolic blood pressure. Analyses examining the effect of drinking pattern indicated that drinking frequency had a positive effect on both diastolic and systolic blood pressure, whereas drinking quantity did not affect either. Furthermore, there was little evidence that the frequency-by-quantity interaction affected blood pressure.

Conclusions: Low average alcohol intake and low blood pressure were associated with infrequent drinking, rather than with frequent drinking of small amounts of alcohol. Results suggest that the standard practice of averaging alcohol consumption may obscure important effects of drinking frequency on health. (*Am J Public Health* 1991;81:452–457)

Marcia Russell, PhD, M. Lynne Cooper, PhD, Michael R. Frone, PhD, and John W. Welte, PhD

Introduction

Despite the well documented relationship between average alcohol intake and elevated blood pressure,[1,2] we know relatively little about the effects of drinking patterns on blood pressure, where patterns are defined in terms of specific combinations of quantity drunk per drinking day and frequency of drinking days. Prior research has typically combined quantity and frequency measures of alcohol intake and expressed this information in terms of average consumption (average drinks per day, per week, or per month). However, such averaging may obscure potentially important differences in blood pressure associated with different drinking patterns. For example, although a person who drinks only two drinks every day of the week and one who has 14 drinks on Saturday night both average two drinks a day, blood pressures associated with these two patterns may not be the same.

To investigate the role of drinking pattern in the relationship of alcohol consumption and blood pressure, we examined the relationship between discrete combinations of quantity and frequency of drinking and average drinks per day; determined the effect of average drinks per day on blood pressure; determined the effect of drinking pattern on blood pressure by analyzing the independent and interactive effects of alcohol quantity and frequency; and contrasted the effects of drinking pattern and average drinks per day on blood pressure.

Methods

Sample

Data for the present analyses came from a representative adult household survey of stress, alcohol use, and hypertension conducted in Erie County, New York (N = 1,933). Respondents were identified using a stratified, three-stage probability sampling procedure designed to yield approximately equal numbers of Blacks and all others at three levels of education (less than high school, high school, at least some college). The first stage of sampling was the selection of US census blocks, stratified by race and education, and selected with probabilities proportional to size. In the second stage, housing units were selected with probabilities inversely proportional to the first stage selection probabilities. Finally, one adult (at least 19 years of age) was randomly selected from each household.

The overall sample completion rate was 78.3 percent, with the majority (84.5 percent) of noncompletions due to refusals. To provide population estimates in the present study, the sample was: poststratified by race, education, and sex (females were unintentionally oversampled) to match proportions reported in the 1980 census for Erie County; and weighted by the individual probability of selection.

Present analyses were conducted on a subset of 1,725 (weighted N = 1,630) respondents. Respondents over age 74 were eliminated (N = 75) because few drank alcohol, blood pressure measurements were missing for many, and doing so made our data more comparable to other studies of alcohol and hypertension. An additional 133 respondents who were

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missing one or more of the study variables were deleted in order to ensure comparability across analyses. After exclusions, the weighted sample was 91 percent White, 54 percent female, and 63 percent married; 70 percent had completed at least a high school education. Mean age was 45 years (SD = 16.5). Forty-eight percent of the sample was working; of these, 51 percent held white collar jobs.

Procedures

Data were collected by a corps of 27 interviewers in the summer and fall of 1986. Interviewers received five days of intensive training on general and survey-specific interviewing techniques and three days of training on physical measurements, including blood pressure measurement. Interviews were conducted in respondents' homes using a highly structured interview schedule that included diet, smoking, and physical activity as well as medical history. The entire procedure took about 90 minutes; respondents were paid $25.

Measures

Blood Pressure: Standardized procedures using the American Heart Association protocol were used to measure systolic and diastolic blood pressures (SBP and DBP, respectively).[3] Blood pressure was assessed using mercury sphygmomanometers (Baumanometer, Model 300) calibrated for accuracy on a weekly basis. Respondents were asked not to drink alcohol during the interview. Properly fitted cuffs were placed on the right arm approximately 15 minutes before the end of the interview; respondents were asked to refrain from smoking, drinking coffee, or moving around the room until after their blood pressures were taken. Readings were made to the nearest 2 mmHg, and DBP was taken at the fifth Korotkoff phase (i.e., cessation of pulse sounds). Mean measures of SBP and DBP based on the last two of three readings were utilized in all analyses.

Alcohol Measures: Alcohol measures were adapted from the National Health and Leisure Time Survey.[4] Standard quantity and frequency questions (see Appendix) were asked on usual drinking during the past year. Average drinks per day was calculated by multiplying frequency of drinking by the number of drinks consumed on a typical day and dividing by 365. Quantity (number of drinks consumed on a typical drinking day—drinks per drinking day) was categorized as one or two drinks, three or four drinks, or five or more. Frequency (drinking days during the past year) was also categorized to yield groups of respondents who drank daily or almost daily, one to four times weekly, or less-than-weekly.

Nine drinking patterns were constructed by cross-tabulating the above quantity and frequency categories. They ranged from less-than-weekly drinkers who usually had one or two drinks per drinking day to those who drank daily or almost daily and usually had five or more drinks.

Covariates: The following potentially confounding factors were statistically controlled in all analyses: age (in years); race (1 = other than Black, 2 = Black); sex (1 = male, 2 = female); body mass index (weight in kg/height in meters, squared); marital status (0 = not married, 1 = married/living as married); education (in years); sodium intake (frequency of using salt at the table, in cooking, and eating salty snacks); calcium intake (milligrams per day based on the frequency of consuming calcium-rich foods, calcium supplements, and calcium-containing antacids); current cigarette use (number of cigarettes smoked per day); and two indices of frequency of physical activity.[5]

Also included as covariates were measures of family history of hypertension, self-reported hypertensive status, and whether or not antihypertensive medication was taken in the 24 hours prior to blood pressure measurement. Because a number of respondents were missing information on family history, two dummy variables were constructed, one to represent information concerning a positive family history of hypertension (family history: positive, coded as 0 = no, 1 = yes), and the other to represent missing information (family history: missing, coded as 0 = no, 1 = yes). Similarly, two dummy variables were used to represent information concerning respondents' self-report of their hypertensive status and current use of antihypertensive medication. The first (hypertension: no medication, coded as 0 = no, 1 = yes) represents individuals who reported that they had been told by a doctor or other health professional that they were hypertensive, but had not taken antihypertensive medication during the past 24 hours. The second dummy variable (hypertension: medication, coded as 0 = no, 1 = yes) represents individuals who reported that they were hypertensive and that they had taken antihypertensive medication during the past 24 hours.

Statistical Analysis

Three sets of statistical analyses were conducted. First, multiple regression was used to examine the relationship of average drinks per day to SBP and DBP, while controlling for covariates.[6]

Second, hierarchical multiple regression analysis was used to examine the independent and interactive effects of frequency and quantity on blood pressure.[6,7] More specifically, the hierarchical regression analysis proceeded in the following manner for both SBP and DBP: a block of covariates was first added to the regression equation in Step 1, followed by continuous measures of frequency and quantity in Step 2, which was followed by the interaction between frequency and quantity in Step 3. These hierarchical regression analyses did not contain abstainers because their inclusion would have led to an unbalanced design (i.e., a design with empty cells);[8] abstainers' scores on the quantity and frequency measures were both fixed at zero. Thus, respondents (i.e., abstainers) who had a zero on frequency could only have a zero on quantity, and vice versa. When a two-factor design is unbalanced, it is inappropriate to test for an interaction among its factors.[8] However, a two-way interaction can be tested if the design can be balanced by removing one or more levels of one or more factors.[8] In the present case, a balanced design was achieved by removing abstainers (i.e., the levels that represented zero frequency and zero quantity). Thus, we tested for a quantity-by-frequency interaction among drinkers only.

Third, to compare adjusted blood pressures in the nine drinking pattern groups with those of abstainers, we conducted two dummy variable regression analyses.[6] In each analysis, we examined the relationship of nine dummy variables to either SBP or DBP, while controlling for the covariates. Each dummy variable represented one of the nine drinking patterns with abstainers serving as the reference category. Therefore, in each regression equation, the unstandardized regression coefficient for a given dummy variable represented the mean difference in adjusted blood pressure for a specific drinking pattern compared to abstainers, and the constant represented the average adjusted blood pressure for abstainers.

As noted earlier, data were weighted to adjust means and regression coefficients for the complex survey design. However, standard errors have not been

TABLE 1—Average Drinks per Day (Mean ± Standard Deviation) by Drinking Patterns [weighted N = 1630*/100%]

	Frequency			
Quantity	Less than Weekly	Weekly	Daily	Total
Light	.05 ± .05	.48 ± .29	1.37 ± .55	.29 ± .43
(1–2 drinks)	[462/28%]	[237/15%]	[58/4%]	[757/47%]
Moderate	.18 ± .10	1.12 ± .51	2.91 ± .61	.92 ± .89
(3–4 drinks)	[163/10%]	[212/13%]	[39/2%]	[413/25%]
Heavy	.42 ± .20	2.62 ± 1.59	6.84 ± 1.46	2.64 ± 2.43
(5+ drinks)	[52/3%]	[101/6%]	[28/2%]	[180/11%]
Total	.11 ± .13	1.12 ± 1.09	3.07 ± 2.29	.79 ± 1.31
	[677/42%]	[550/34%]	[124/8%]	[1351/83%]

*Including abstainers: Weighted n = 279/17%.

TABLE 2—Regression Coefficients and Standard Errors of Multiple Regression of Systolic and Diastolic Blood Pressure on Average Drinks per Day and Covariates (N = 1630*)

	Systolic Blood Pressure		Diastolic Blood Pressure	
Variables	b	Standard Error	b	Standard Error
Age	.47	.03	.11	.02
Sex	−6.53	.78	−5.00	.51
Race	.06	1.29	1.19	.85
Body Mass	.34	.07	.26	.05
Marital Status	−2.12	.78	−.26	.51
Education	−.56	.15	−.09	.10
Sodium Intake	−.37	.20	−.38	.13
Calcium Intake	−.002	.001	−.003	.001
Family History: Positive	2.07	.87	1.14	.57
Family History: Missing	1.31	1.55	−.63	1.02
Hypertension: No Medication	8.78	1.02	5.73	.67
Hypertension: Medication	9.32	1.22	2.35	.80
Current Cigarette Use	.01	.03	−.005	.02
Activity	.46	.41	−.24	.27
Exercise	−.004	.02	−.01	.02
Average Drinks per Day	1.21	.32	.55	.21
Constant	108.13	4.03	71.59	2.64

*Abstainers included.

adjusted for design effects because the requisite statistical programs to do so were not available to us.

Results

Drinking Pattern

Mean values for average drinks per day associated with each pattern are presented in Table 1. As expected, marginal values for average drinks per day increased both as the frequency of drinking increased (r = .64) and as the usual quantity consumed on a typical drinking day increased (r = .56). Heavy drinking was more prevalent among daily drinkers than among those who drank less frequently. However, the magnitude of the relationship among drinkers is relatively modest (r = .23), which provides further justification for analyzing the independent and interactive effects of quantity and frequency on blood pressure.

Although quantity definitely influences average drinks per day, given the distribution of drinking in this household sample, frequency seems to play a more important role than quantity in determining which drinking patterns are associated with lower mean values of average drinks per day and which are associated with higher values. For example, mean averages of one drink or more per day were associated with moderate and heavy weekly drinking, and with daily drinking, irrespective of quantity; averages of less than one drink per day were associated with light, weekly drinking and less-than-weekly drinking, irrespective of quantity.

The most prevalent drinking patterns, accounting for 43 percent of the population, were characterized by light drinking less-than-weekly or weekly, both of which were associated with low average drinks per day. In contrast, only 8 percent of the population drank as often as daily or nearly every day.

Blood Pressure

Results of the multiple regression equations predicting SBP and DBP from average drinks per day are summarized in Table 2. Blood pressure had the expected relation to all covariates except race and sodium intake. Failure to observe higher average blood pressures among Blacks than Whites reflects their relatively small weighted numbers in these population-based analyses. Unweighted analyses are planned to investigate racial differences in the relation of blood pressure to drinking patterns. The negative relation of blood pressure to sodium intake reflects the lower discretionary salt intakes among individuals who had been told they were hypertensive, presumably in response to medical advice.

After covariates were taken into consideration, average drinks per day made a statistically significant contribution to the prediction of both SBP and DBP. The b values indicate that SBP was elevated an average of 1.21 mmHg, and DBP was elevated an average of 0.55 mmHg, for every increment of one drink in average drinks per day.

Drinking Pattern and Blood Pressure

Systolic Blood Pressure: The hierarchical regression analysis examining the independent and interactive effect of quantity and frequency on SBP revealed a significant positive relationship between frequency and SBP, but no significant effect for quantity and no significant quantity-by-frequency interaction (Table 3). The b value for frequency of drinking days during the past year indicated that SBP increased .021 mmHg with every additional day of drinking. Thus, SBP would be an average of 6.6 mmHg higher among those who drank daily than among those who drank only once a week (365 − 52 = 313 × .021 mmHg per drinking day per year = 6.6 mmHg).

TABLE 3—Regression Coefficients and Standard Errors of Hierarchical Multiple Regression of Systolic and Diastolic Blood Pressure on Drinking Frequency, Quantity, and Covariates among Drinkers (N = 1351*)

	Systolic Blood Pressure		Diastolic Blood Pressure	
Variables	b**	Standard Error	b**	Standard Error
Step 1				
Age	.47	.03	.13	.02
Sex	−6.88	.81	−5.80	.54
Race	.02	1.47	1.42	.99
Body Mass	.46	.08	.31	.05
Marital Status	−3.08	.63	−.93	.56
Education	−.48	.17	.09	.11
Sodium Intake	−.40	.21	−.33	.14
Calcium Intake	−.001	.001	−.002	.001
Family History: Positive	1.79	.91	1.29	.61
Family History: Missing	1.00	1.78	−1.20	1.19
Hypertension: No Medication	8.28	1.09	5.32	.73
Hypertension: Medication	11.19	1.35	2.23	.91
Current Cigarette Use	.02	.03	.01	.02
Activity	.88	.43	−.13	.29
Exercise	.02	.03	.01	.02
Step 2				
Quantity	.15	.19	−.011	.13
Frequency	.021	.004	.015	.003
Step 3				
Quantity-by-Frequency	−.001	.002	−.003	.001

*Abstainers omitted.

**Regression coefficients were taken from the step at which they were entered; therefore, each coefficient is controlled for all other variables entered at the same step and prior steps.

The dummy variable regression analysis comparing SBP among abstainers and drinkers found that compared to abstainers, mean SBP was significantly higher among light daily, moderate weekly, moderate daily, or heavy weekly drinkers (Table 4). These results paralleled the hierarchical regression results, indicating that relative to abstention, more frequent drinking was associated with increased SBP within each quantity category, whereas a tendency for SBP to increase with quantity was observed only among weekly drinkers.

Diastolic Blood Pressure: Overall, the main effects of the hierarchical regression analysis examining the independent and interactive effect of quantity and frequency on DBP were similar to those observed for SBP (Table 3). The b value for frequency indicated that DBP increased .015 mmHg with every additional day of drinking. Thus, DBP would be approximately 4.7 mmHg higher among daily drinkers compared to the individual who drank once a week.

In addition, there was a quantity-by-frequency interaction (Table 3). We explored the nature of the interaction by analyzing the effect of frequency among light, moderate, and heavy drinkers, and the effect of quantity among less-than-weekly, weekly, and daily drinkers. This set of follow-up analyses, however, failed to uncover a strong, readily interpretable, functional form for the quantity-by-frequency interaction. The fact that this interaction was weak and failed to replicate with systolic blood pressure indicates that it may be a chance finding.

The dummy variable regression analysis comparing DBP among abstainers and drinkers found that, compared to abstainers, mean DBP was significantly higher among light weekly, light daily, or moderate daily drinkers (Table 4). Again, these results supported the hierarchical regression results by indicating that relative to abstention, more frequent drinking increased DBP at every level of quantity, but that higher quantity did not increase DBP within the frequency categories.

Discussion

To summarize, our analyses revealed a significant increase in blood pressure, particularly SBP, with increasing average drinks per day. However, consideration of drinking patterns indicated that, among drinkers, this increase was influenced more by the frequency of drinking than by the quantity of alcohol consumed. Although a quantity-by-frequency interaction was observed for DBP, it was not observed for SBP, and its pattern had no ready explanation. Finally, relative to abstainers, respondents who drank less often than weekly tended to have lower blood pressures, and those who drank weekly or more often tended to have higher blood pressures.

As reviewed by Gleiberman and Harburg,[9] a number of epidemiological studies have reported that individuals having relatively low average alcohol intakes tend to have lower mean blood pressures than abstainers, exhibiting a U- or J-shaped alcohol-blood pressure relation. Although not statistically significant, this tendency was also observed in the present study, as indicated by the fact that blood pressure among abstainers tended to be higher than that among less-than-weekly drinkers, who had low average drinks per day. Studies are needed to determine whether very light or occasional alcohol use exerts a physiological protective effect or if it is associated with psychological or behavioral correlates related to lower blood pressure.[9]

Methods employed to measure and analyze alcohol-blood pressure relationships may influence its interpretation. Studies in alcoholic men[10] and pregnant women[11] found that self-reported frequency was more reliable than self-reported quantity. Thus, lower reliability may have contributed to our failure to observe a significant effect of quantity on blood pressure in the present study. Also, it is important to note that the prepotency of frequency in the relationship between alcohol use and blood pressure is obscured by employing measures of average alcohol intake. Analyses of drinking pattern, in which the independent and interactive effects of quantity and frequency are taken into consideration, clearly indicate that drinking patterns characterized by infrequent drinking are associated both with low blood pressures and relatively low average drinks per day. Conversely, daily drinking is associated both with high blood pressures and relatively high average drinks per day.

Data from the 1979 National Survey of US drinking practices indicate that light, daily drinking was reported by only 2 percent of the US population,[12] suggesting that relatively few people who report low average drinks per day are light, daily drinkers. Therefore, it may be misleading to attribute purported health benefits as-

TABLE 4—Regression Coefficients and Standard Errors of Multiple Regression of Systolic and Diastolic Blood Pressure on Drinking Patterns

	Systolic Blood Pressure		Diastolic Blood Pressure	
Variables	b	Standard Error	b	Standard Error
Age	.46	.03	.09	.02
Sex	−6.46	.79	−4.90	.52
Race	.12	1.29	1.23	.84
Body Mass	.36	.07	.29	.05
Marital Status	−2.14	.79	−.42	.51
Education	−.68	.15	−.19	.10
Sodium Intake	−.38	.20	−.39	.13
Calcium Intake	−.001	.001	−.002	.001
Family History: Positive	2.06	.87	1.03	.57
Family History: Missing	1.60	1.55	−.57	1.02
Hypertension: No Medication	8.52	1.02	5.63	.67
Hypertension: Medication	9.04	1.21	2.16	.79
Current Cigarette Use	.02	.03	−.002	.02
Activity	.45	.41	−.34	.27
Exercise	−.01	.02	−.01	.02
Light, Less-Than-Weekly	.87	1.13	−1.17	.74
Light, Weekly	2.10	1.36	2.24	.89
Light, Daily	8.55	2.17	6.87	1.42
Moderate, Less-Than-Weekly	−1.81	1.50	−.32	.98
Moderate, Weekly	3.46	1.43	.38	.93
Moderate, Daily	6.33	2.55	3.77	1.67
Heavy, Less-Than-Weekly	−3.50	2.35	−1.47	1.54
Heavy, Weekly	5.16	1.82	.81	1.19
Heavy, Daily	5.07	2.99	2.87	1.95
Constant (Abstainers)*	108.45	4.20	72.33	2.74

*Because abstainers served as the reference category, the constant represents the adjusted blood pressure for abstainers. The b weights for each drinking pattern (e.g., light, less-than-weekly) represent the magnitude of the difference in blood pressure for the drinking pattern compared to abstainers. Thus, the adjusted blood pressure for each drinking category is equal to the sum of the constant and its b weight.

sociated with low average drinks per day to light, daily drinking.

We believe that recognition of the importance of drinking frequency in determining the effects associated with average drinks per day is important for public health policy. The relatively low correlation between quantity and frequency among drinkers and the fact that few people in the US drink daily,[12] suggests that average drinks per day does not adequately represent actual drinking practices in the US. Accordingly, findings of health risks or benefits based on analyses employing average drinks per day cannot be translated directly into public health policy. The present data suggest that previously reported health benefits associated with low average drinks per day[2,9] are likely to be related to light, weekly drinking and infrequent drinking, rather than to light, daily drinking.

This is the first time that elevations in blood pressure have been attributed to drinking frequency, even in light drinkers, and it is important that these analyses be replicated. Assuming for the moment that they prove to be reliable, it is interesting to speculate about how frequent drinking might influence blood pressure. It has been hypothesized that individuals who recently drank alcohol may have elevated blood pressure because they are experiencing mild withdrawal symptoms or direct pressor effects of alcohol.[2] If this is so, it may be that individuals in our sample who reported drinking daily or nearly every day were more likely to be undergoing these effects. Criqui, *et al,*[13] have noted that repeated acute elevations in blood pressure related to frequent alcohol use are functionally equivalent to a chronic condition. Thus, elevations in blood pressure related to daily drinking could have significant implications for cardiovascular health and should not be dismissed as a short-term phenomenon.

Mean SBP was 6.6 mmHg higher and DBP was 4.7 mmHg higher among daily drinkers than among individuals who drank only once a week. Blood pressure elevations of this magnitude have both clinical and population significance. The association of DBP with stroke and with coronary heart disease (CHD) was recently investigated in nine major prospective observational studies, correcting for risk underestimates in previous reports related to "regression dilution" bias.[14] It was found that a long-term difference of 5–6 mmHg in usual DBP was associated with about 35–40 percent less stroke and 20–25 percent less CHD.[14] Data from the Multiple Risk Factor Intervention Trial[15] indicate that SBP is more strongly associated with CHD death than DBP, suggesting that the effect of frequent drinking on SBP may represent a greater CHD risk than is indicated by its effect on DBP.

The potential effect on health of relatively small reductions in mean blood pressure is illustrated by an overview of unconfounded randomized trials of antihypertensive drugs.[16] In 14 such trials, the mean treatment duration was five years, lowering mean DBP 5–6 mmHg; stroke was reduced by 46 percent, and CHD was reduced by 14 percent.

Within the DBP range covered by prospective observational studies (about 70–100 mmHg), there was no evidence of any "threshold" below which lower levels of DBP were not associated with lower risks of stroke and of CHD. Although increased risk may be small at lower DBP levels, the net effect is substantial when aggregated over the large numbers of people affected. Also, there are large numbers of individuals with moderately elevated blood pressures among whom relatively small increases might result in levels associated with diagnosed hypertension.

In sum, the effect of alcohol consumption on blood pressure has public health as well as clinical relevance. The present study illustrates how the standard practice of averaging alcohol consumption may obscure important effects of drinking pattern on health, and it is important that the study be replicated to determine the reliability of its findings. These results suggest that it may be useful to examine the independent and interactive effects of drinking quantity and frequency on other conditions thought to be influenced by alcohol intake, as well as in future epidemiologic studies of the alcohol-blood pressure relationship. ☐

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APPENDIX

Frequency: **Thinking back over the past 12 months, how often did you drink any kind of alcoholic beverage, that is, beer, wine, and liquor? Asked only of people who had reported drinking during the past year, respondents chose from eight categories: every day; almost every day; three or four times a week; two times a week; once a week; two or three times a month; once a month; or less than once a month.**

Quantity: **During the past 12 months, about how many drinks, on the average, would you have on a typical day when you drank? A drink is a 4 oz glass of wine, a 12 oz beer, or a drink containing 1 oz of liquor. Responses were open-ended.**

Caffeine Consumption During Pregnancy and Fetal Growth

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ABSTRACT

Background: The purpose of this study was to examine the association between maternal caffeine consumption and low birthweight, intrauterine growth retardation, and prematurity, adjusting for multiple confounders.

Methods: Data obtained from birth certificates and interviews on 1,230 women with singleton live births were analyzed to evaluate the potential influence of caffeine consumption during the first trimester on fetal growth.

Results: The crude odds ratio for intrauterine growth retardation in infants of women reporting heavy caffeine consumption (>300 mg/day) was 3.86 (95% CI = 1.80, 8.40) which decreased to 2.90 (95% CI = 1.23, 6.87) after controlling for confounding factors. The adjusted odds ratio for low birthweight and heavy maternal caffeine consumption was also elevated (OR = 2.05; 95% CI = 0.86, 4.88). Women who reduced their caffeine intake from greater than 300 mg/day to less than that early in pregnancy had lower risks of delivering infants with either intrauterine growth retardation or low birthweight than women who continued to consume that amount. Preterm delivery appeared to be unrelated to caffeine consumption.

Conclusions: Taken together with studies reporting similar findings, these results suggest that heavy caffeine consumption increases the risk for fetal growth retardation. (*Am J Public Health* 1991;81:458–461)

Introduction

In 1980, the United States Food and Drug Administration warned pregnant women to restrict their intake of caffeine based on increased adverse reproductive outcomes in animals.[1] Since then, a number of epidemiologic studies have examined the association between caffeine intake and low birthweight (LBW) and a few have investigated its relationship to intrauterine growth retardation (IUGR). In a prospective study, Martin and Bracken found a more than two-fold risk of LBW in term deliveries associated with caffeine intake of 151–300 mg daily during the first trimester and a greater than four-fold risk associated with intake of >300 mg daily.[2] A case-control study which combined cases of LBW and IUGR found an increased risk associated with caffeine intake greater than 300 mg daily during the first trimester (OR = 2.94; 95% CI = 0.89, 9.65).[3] In addition, a retrospective study demonstrated a relationship between caffeine consumption of greater than 300 mg daily and reduced birthweight.[4] In contrast, a prospective[5] and a large retrospective[6] study found no relationship between caffeine or coffee consumption and reduced birthweight, respectively.

Methods

Participants and Questionnaires

Participants were women selected as controls in a case-control study of spontaneous abortion (SAB); a detailed description of subject selection and recruitment is presented elsewhere.[7] Birthweight was obtained from birth certificates. LBW was defined as birthweight less than 2,500 grams. Gestational age was calculated from the date of the last menstrual period (LMP) to the baby's birth date, as reported on interview. IUGR was defined as weight less than the tenth percentile of the mean weight at each gestational week using standards developed for California (all races and sexes combined).[8] Preterm delivery was defined as gestational age of less than 37 weeks.

The interview was conducted by telephone, on average, nine months after birth. For caffeinated beverage consumption questions (caffeinated coffee, tea and soft drinks), the participant was asked the amount consumed during the month before pregnancy, if it changed during pregnancy and, if so, when and to what amount. This information was used to calculate each participant's average consumption during the first trimester of pregnancy, based on her consumption each week. Caffeine consumption was calculated by summing the average amount of caffeinated coffee, tea, and soft drinks consumed, assuming a caffeine content of 107 mg/cup, 34 mg/cup, and 47 mg/can, respectively.[9]

The analyses were limited to singleton births (n = 1,252). Women who were missing information on birthweight (n = 1) or on caffeine consumption (n = 8) or whose calculated gestational age was 45 weeks or more (n = 13) were excluded from the analyses, leaving 1,230 singleton live births.

From the Reproductive Epidemiology Program, California Department of Health Services, Berkeley (Fenster, Windham, Swan); and the Departments of Maternal and Child Health and Epidemiology, University of California School of Public Health, Berkeley (Eskenazi). This paper, submitted to the Journal March 19, 1990, was revised and accepted for publication October 10, 1990.

Statistical Analyses

We examined maternal characteristics within four categories of caffeine consumption consistent with those from previous studies:[2–4] no caffeine; average caffeine use of 1–150 mg/day (light use); 151–300 mg/day (moderate use); and >300 per/day (heavy use). Analysis of variance was used to determine whether mean birthweights or mean gestational ages differed by category of caffeine use. Unadjusted odds ratios (OR), confidence intervals (CI) and chi-square trend tests were calculated for three levels of caffeine consumption with no consumption as the reference group.

Adjusted odds ratios were calculated using logistic regression with indicator variables for light, moderate, and heavy caffeine use. Caffeine was also modeled as a continuous variable. Since results were similar, categorical variables are presented for ease of comparison to other studies.

Confounding variables were included if they were strongly related to LBW or related to both LBW and caffeine use. The following maternal characteristics were entered into the LBW models: maternal age (≤34, >34); parity (0, ≥1); race (White, Hispanic, other); hypertension during pregnancy (yes, no); cigarettes smoked (0, 1–10 daily, ≥11 daily); and alcohol consumed (0, 1–3 drinks per week, ≥4 drinks per week). Separate models were run to test for an interaction between caffeine and tobacco use and between caffeine and alcohol consumption.

Reductions in caffeine consumption early in pregnancy were examined to determine whether these changes might affect fetal growth. Crude and adjusted odds ratios were calculated separately for women who did and did not reduce their intake from greater than an average of 300 mg/day to less than that amount within six weeks of their LMP. The reference group for these analyses was women with no caffeine consumption. Six weeks post-LMP was chosen as the time to evaluate the effect of reducing caffeine consumption because it approximates the earliest time that a woman realizes she is pregnant.

The strategy outlined above was followed for the univariate and multivariate analyses of caffeine consumption and IUGR or prematurity. The following covariates were entered in the models for IUGR: hypertension, cigarettes, and alcohol, as defined above. Variables included in the models for prematurity were: education (less than high school, high school graduate, some college, college graduate), race, hypertension, cigarettes and alcohol.

Results

Characteristics of Study Population

Table 1 presents population characteristics by four categories of caffeine consumption. The following variables were associated with increased caffeine consumption: multiparity, one or more therapeutic abortions, being employed, and use of cigarettes or alcohol. Ethnicity other than White or Hispanic was associated with decreased caffeine consumption, as was being more highly educated.

Association with LBW, IUGR

Overall, the risk factors for LBW were consistent with previous studies.[10] Nulliparous women over 34 years of age were at increased risk for delivering a LBW infant. Prior stillbirth, hypertension during the current pregnancy, smoking more than 10 cigarettes per day, or drinking four or more alcoholic drinks each week were associated with LBW. Race was also associated with LBW; Whites were least likely to deliver a LBW infant. Women who did not have insurance coverage for prenatal care (a surrogate measure for low socioeconomic status) were also at increased risk for LBW. IUGR was more common among women with hypertension during pregnancy, smoking more than 10 cigarettes per day, or drinking four or more alcoholic drinks per week.

Association of LBW and Caffeine

The mean birthweights for no, light, moderate, and heavy caffeine use were 3327 grams, 3311 grams, 3288 grams and 3170 grams respectively. Table 2 presents the unadjusted and adjusted odds ratios for LBW by caffeine consumption. A dose-response effect with increasing consumption of caffeine was observed (χ^2 trend = 4.03, p = 0.05). The crude risk for those with the heaviest level of caffeine consumption was twice that in the unexposed group. Adjusting for covariates resulted in a slightly lowered measure of association. Including interaction terms for cigarette smoking and caffeine consumption and for alcohol and caffeine consumption did not alter these estimates. Women who reduced their heavy caffeine consumption (within six weeks of their LMP) had a lower risk of delivering a LBW infant (adjusted OR = 0.65; 95% CI = 0.20, 2.11) than those women who continued to drink this amount (adjusted OR = 3.05; 95% CI = 1.09, 8.51).

Association of IUGR and Caffeine

The association of caffeine and IUGR increased with amount (χ^2 trend = 11.42, p = 0.0007), with a doubled risk for medium consumers and almost a four-fold risk for heavy consumers (Table 3). The adjusted OR for heavy caffeine consumption remained elevated, although decreased (OR = 2.90). Addition of interaction terms for cigarette smoking and caffeine consumption and for alcohol and caffeine consumption did not alter these estimates. Women who reduced their heavy caffeine consumption had a lower risk of IUGR (adjusted OR = 1.58; 95% CI = 0.56, 4.42) than women who continued this level of caffeine intake (adjusted OR = 3.74; 95% CI = 1.34, 10.41).

Association of Preterm Delivery and Caffeine

Mean gestational age varied little by caffeine use. Although the crude odds ratio for preterm delivery and heavy caffeine consumption was somewhat elevated (OR = 1.76), this estimate was decreased after multivariate adjustment (adjusted OR = 1.31; 95% CI = 0.63, 2.69). Women who continued their heavy caffeine consumption had a higher risk of preterm delivery (adjusted OR = 1.72; 95% CI = 0.70, 4.24) than women who reduced their intake (adjusted OR = 1.10; 95% CI = 0.50, 2.43).

Discussion

This study indicated elevated risks for IUGR and for LBW associated with heavy caffeine consumption which continued beyond the sixth week of pregnancy. Recall bias is an unlikely explanation of these findings since little relationship between preterm delivery and caffeine consumption was seen. Consistency of reporting of caffeinated beverage consumption was examined in a smaller case-control study of SAB,[11] in which caffeine consumption was asked as in this study. Substantial agreement for reports of caffeine consumption between interviews which were six months apart was found; approximately 77 percent of women's responses agreed to within one cup.[11] In addition, reporting of coffee consumption has recently been shown to have good reliability over a period of time which ranged from nine days to 6.5 years.[12]

TABLE 1—Distribution of Maternal Characteristics by Level of Caffeine Consumption during Pregnancy, Santa Clara County, California, 1986–87

	Daily Caffeine Consumption					
Variables*	Total	None	Light (1–150 mg)	Moderate (151–300 mg)	Heavy (>300 mg)	p-value
Subjects (N)	1230	378	609	165	78	
Subjects (%)	100	30.7	49.5	13.4	6.4	
Maternal Age (years)						
≤34	1072	30.6	50.5	13.1	5.8	p = 0.11
>34	158	31.7	43.0	15.2	10.1	
Parity						
0	507	31.2	53.3	12.2	3.3	p = 0.002
≥1	719	30.6	46.7	14.3	8.3	
Previous Spontaneous Abortions						
0	982	31.0	50.2	13.3	5.5	p = 0.14
≥1	244	30.3	46.3	13.9	9.4	
Previous Therapeutic Abortions						
0	969	32.9	48.8	12.7	5.6	p = 0.006
≥1	257	24.0	51.8	16.3	8.9	
Previous Stillbirths						
0	1197	30.9	49.5	13.4	6.2	p = 0.83
≥1	29	27.6	48.3	13.8	10.3	
Race						
Hispanic	320	28.1	50.3	15.0	6.6	p = 0.002
White	639	27.8	51.0	13.5	7.7	
Other	270	40.7	45.2	11.1	3.0	
Education						
<High School	202	27.7	49.0	16.8	6.5	p = 0.001
High School Graduate	357	23.3	51.5	15.7	9.5	
Some College	346	35.2	48.0	11.3	5.5	
College Graduate	325	36.0	49.2	11.1	3.7	
Marital Status						
Together	1123	31.0	49.8	13.2	6.0	p = 0.32
Apart	107	28.0	46.7	15.0	12.3	
Insurance Coverage						
Yes	1098	30.1	50.0	13.6	6.3	p = 0.60
No	132	35.6	45.5	12.1	6.8	
Employment						
Yes	870	27.9	51.4	14.0	6.7	p < 0.001
No	359	37.6	45.1	12.0	5.3	
Hypertension during Pregnancy						
Yes	45	33.3	37.8	20.0	8.9	p = 0.33
No	1183	30.6	50.0	13.2	6.2	
Cigarettes/day						
0	998	34.8	51.0	10.2	4.0	p < 0.001
1–10	146	18.5	42.5	26.7	12.3	
≥11	86	4.6	44.2	27.9	23.3	
Alcoholic Drinks/day						
0	566	39.2	45.9	20.8	4.2	p < 0.001
1–3	598	24.9	52.7	15.5	6.9	
≥4	62	9.7	53.2	17.7	19.4	

*Numbers for some variables do not total 1,230 because of missing data. Percentages for some variables do not total 100 because of rounding errors.

In these analyses, pre-pregnancy weight and pregnancy weight gain—maternal characteristics known to be associated with fetal growth—were not collected.[10] In Martin and Bracken's study, although caffeine users tended to gain less weight than nonusers, the caffeine risk estimates were only slightly reduced when weight gain was entered into the logistic models.[2] Birthweight and IUGR may also be influenced by exposures occurring during the second and third trimesters which were not ascertained. However, a case-control study found that average coffee and tea consumption in the second and third trimesters did not differ appreciably from that in the first trimester.[13]

There are two potential sources of exposure misclassification. We did not collect information on caffeine intake from caffeinated drug use, chocolate, or cocoa. This bias is unlikely to be substantial since for most pregnant women the largest source of caffeine intake is coffee.[4,14] Nevertheless, our measures of caffeine consumption were crude, given the substantial variation in caffeine content with method of beverage preparation and volume of serving.[9]

Our results suggest an effect of caffeine consumption of greater than 300 mg/daily on IUGR and LBW but not preterm delivery. These findings are consis-

TABLE 2—Odds Ratios for LBW and Caffeine Consumption, Santa Clara County, California, 1986–87

Caffeine Intake*	Case	Control	Crude OR	95% CI†	Adjusted OR††	95% CI†
0	27	351	1.00	—	1.00	—
1–150	34	575	0.77	(0.46, 1.29)	0.78	(0.45, 1.35)
151–300	14	151	1.21	(0.63, 2.38)	1.07	(0.51, 2.21)
>300	12	66	2.36	(1.17, 4.93)	2.05	(0.86, 4.88)
Total	87	1143				

*Average consumption during first trimester, including any changes in habit.

†Confidence Interval calculated by Cornfield's method (using Epistat).

††Adjusted by logistic regression for age, parity, race, hypertension during pregnancy and cigarette and alcohol consumption during pregnancy.

TABLE 3—Odds Ratios for IUGR and Caffeine Consumption, Santa Clara County, California, 1986–87

Caffeine Intake*	Case	Control	Crude OR	95% CI†	Adjusted OR††	95% CI†
0	17	361	1.00	—	1.00	—
1–150	41	568	1.53	(0.85, 2.68)	1.45	(0.80, 2.63)
151–300	14	151	1.97	(0.96, 4.08)	1.58	(0.73, 3.41)
>300	12	66	3.86	(1.80, 8.40)	2.90	(1.23, 6.87)
Total	84	1146				

*Average consumption during first trimester, including any changes in habit.

†Confidence Interval calculated by Cornfields Method (using Epistat).

††Adjusted by logistic regression for hypertension during pregnancy and cigarette and alcohol consumption.

tent with those of other studies[2–4] and are biologically plausible. Caffeine is readily absorbed from the digestive tract and freely crosses the placenta.[15,16] Caffeine increases intercellular cyclic 3′,5′-adenosine monophosphate (cyclic AMP), which may directly interfere with fetal development.[17] A dose of 200 mg of caffeine significantly decreases blood flow in placental villi,[18] probably through vasoconstriction.[19] Any reduction in uteroplacental circulation is strongly associated with decreased fetal growth.[10] IUGR[20] and LBW[10] are associated with increased risks of perinatal mortality and morbidity. Clinicians should counsel women early in pregnancy about reducing caffeine intake to below 300 mg daily. □

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Does Increased Detection Account for the Rising Incidence of Breast Cancer?

Jonathan M. Liff, PhD, John F. C. Sung, PhD, Wong-Ho Chow, PhD, Raymond S. Greenberg, MD, PhD, and W. Dana Flanders, MD, DSc

ABSTRACT

Background: The incidence of breast cancer has been increasing over time in the United States.

Methods: To determine the role of screening in this increase, trends in the incidence of *in situ* and invasive carcinoma of the breast were evaluated using records of the metropolitan Atlanta SEER program between 1979 and 1986. From a sample of records, evidence of symptoms and mammographic screening prior to diagnosis was recorded.

Results: The average annual age-adjusted incidence of invasive disease rose 29 percent among Whites and 41 percent among Blacks. Incidence increased in all age groups. A trend towards earlier detection of invasive disease was found. Asymptomatic tumors accounted for only 40 percent of the increased incidence among whites and 25 percent of the increased incidence among blacks, with mammography as the principal contributing procedure.

Conclusions: These data suggest that increased detection accounts for some but not all of the rising incidence of breast cancer in the United States. (*Am J Public Health* 1991;81:462–465)

Introduction

A rise in the incidence of breast cancer has been observed in the United States during the past decade.[1-5] In part, this phenomenon may be attributable to the increasing prevalence of suspected risk factors.[6-11] Alternatively, increased mammographic screening[12,13] could have resulted in more complete recognition of disease. This study was undertaken to determine whether the trends in breast cancer incidence could be explained by increased screening.

Methods

Data for this study were collected by a population-based cancer registry that has been described elsewhere.[14] Briefly, clinical and demographic data are collected on all new cases of cancer diagnosed among residents of five counties in metropolitan Atlanta. The majority of cases are identified from records at local hospitals, supplemented by case-finding from free-standing pathology laboratories, outpatient clinics, physicians' offices, and death certificates. The present study concerns all cases of *in situ* or invasive breast carcinoma first diagnosed among females between 1979 and 1986.

Race- and age-specific incidence rates of *in situ* and invasive breast cancer by stage were computed for each of four consecutive two-year time periods between 1979 and 1986, using population estimates derived by the US Bureau of the Census[15] and the National Cancer Institute. The incidence rates were age-adjusted to the 1970 US population 20 years of age and older, and approximate 95 percent confidence intervals (CIs) were calculated.[16] Age-adjusted incidence rate ratios with corresponding approximate 95 percent CIs[17] were calculated for each subsequent time period relative to 1979–80, and tests for trends over time were performed with Poisson regression.[18]

Probability samples of registry abstracts for patients with invasive disease (n = 100 Blacks, 100 Whites) in each of two time periods, 1979–80 and 1985–86, were also reviewed to characterize the process that led to cancer detection.

Results

The overall average annual age-adjusted incidence rates of both *in situ* and invasive breast cancer among Whites rose during this study (Figure 1). The climbing incidence of invasive malignancies, however, was confined to patients with localized disease at diagnosis. Among Blacks, no increase in the age-adjusted incidence rate of *in situ* breast carcinoma was observed until 1985–86 (Figure 2). The corresponding incidence of invasive breast cancer, in contrast, rose consistently over time. The increase in incidence occurred mainly in patients with localized disease, except for a climb in regional disease during the most recent time period.

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For both races, incidence rates increased temporally in each of the age groups 20–49, 50–64, and 65 or over. Tables detailing the changes in rates over time will be provided upon request.

Age-adjusted incidence rates of *in situ* breast cancer more than doubled among Blacks from 1979–80 to 1985–86 (rate ratio [RR] = 2.3), and more than tripled among Whites (RR = 3.7). This increase was greatest for those aged 50 or older among Whites, and among those within the age group 50–64 among Blacks. For invasive breast malignancies, the temporal trends in incidence were more homogeneous across age groups. Overall, the rate ratios over time, with 1979–80 as the reference period, were greater for Blacks (45 percent increase) than Whites (26 percent increase).

Review of records for a sample of patients with invasive malignancies revealed that the proportion of patients who were asymptomatic or without a recorded symptom increased to 10 percent of both White and Black patients (Table 1). The majority of these women were diagnosed with a mammogram, either with or without an accompanying physical examination. The proportion of patients who were symptomatic but who were also diagnosed with a mammogram rose to 32 percent among Whites and 15 percent among Blacks (Table 1). Among Blacks, the increasing use of mammography was evident among patients with localized disease, but not among those with more extensive disease at diagnosis (Table 2). Among Whites, however, a substantial increase in the use of mammography was observed in both localized and nonlocalized disease categories.

Among Whites, about 2 percent of invasive cancers diagnosed in 1979–80 were asymptomatic (Table 1). Multiplication of this percentage by the age-adjusted invasive incidence rate for that time period (119.5 per 100,000) yielded an estimate of the age-adjusted rate of asymptomatic cancers (viz., 2.4 per 100,000). The corresponding estimate for Whites during 1985–86 was 15.1 per 100,000, or 40.2 percent of the total increase in breast cancer occurrence between these two time periods. The corresponding percentage for Black women was 25.4 percent. By similar reasoning, asymptomatic tumors reported as mammographically detected accounted for an estimated 20.1 percent of the increase among Whites and 12.8 percent among Blacks.

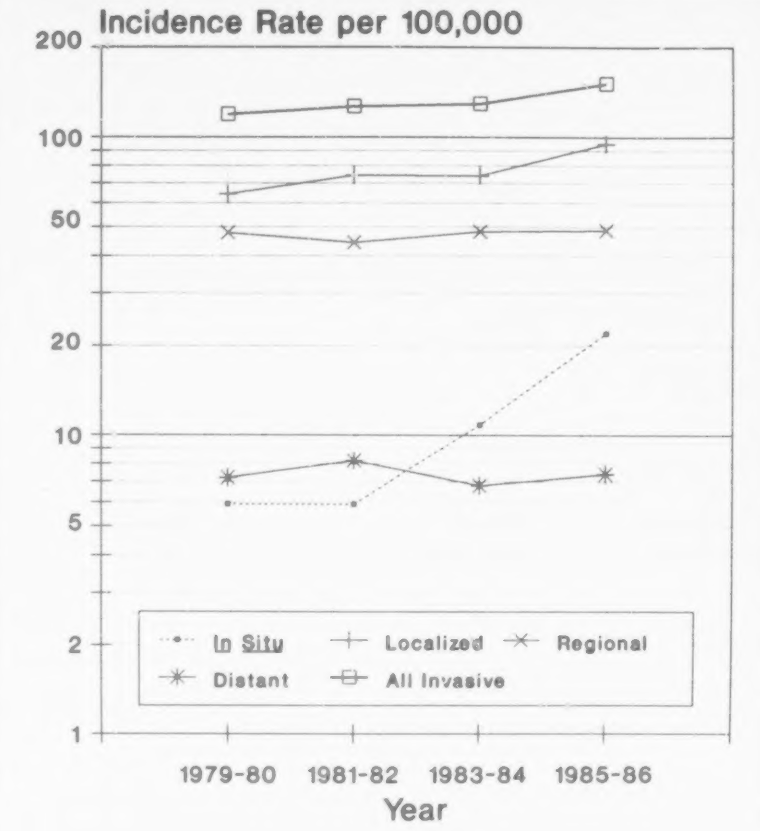

FIGURE 1—Trends over Time in Age-Adjusted Average Annual Incidence of Breast Carcinoma among White Women in Atlanta, by Stage.

TABLE 1—Percentage Distribution of Reported Detection Circumstances for Sampled Patients in Atlanta, Stratified by Race and Time Period of Diagnosis

	White		Black	
Detection circumstances	1979–80	1985–86	1979–80	1985–86
Symptoms Present				
Symptoms only	61	47	85	60
Physical examination	4	2	3	5
Mammography	16	29	4	15
Both examination and mammography	2	3	0	0
Other*	14	8	5	6
Symptoms Absent				
Physical examination	1	1	0	0
Mammography	1	5	0	4
Both examination and mammography	0	3	0	3
Other*	0	1	3	3
Symptom History Unknown	1	0	0	4
Total	100 (n = 100)	100 (n = 99†)	100 (n = 100)	100 (n = 99†)

*Detected during medical management of other conditions, such as back pain, gastroenteritis, diabetes mellitus, or benign breast disease.

†One medical record could not be located.

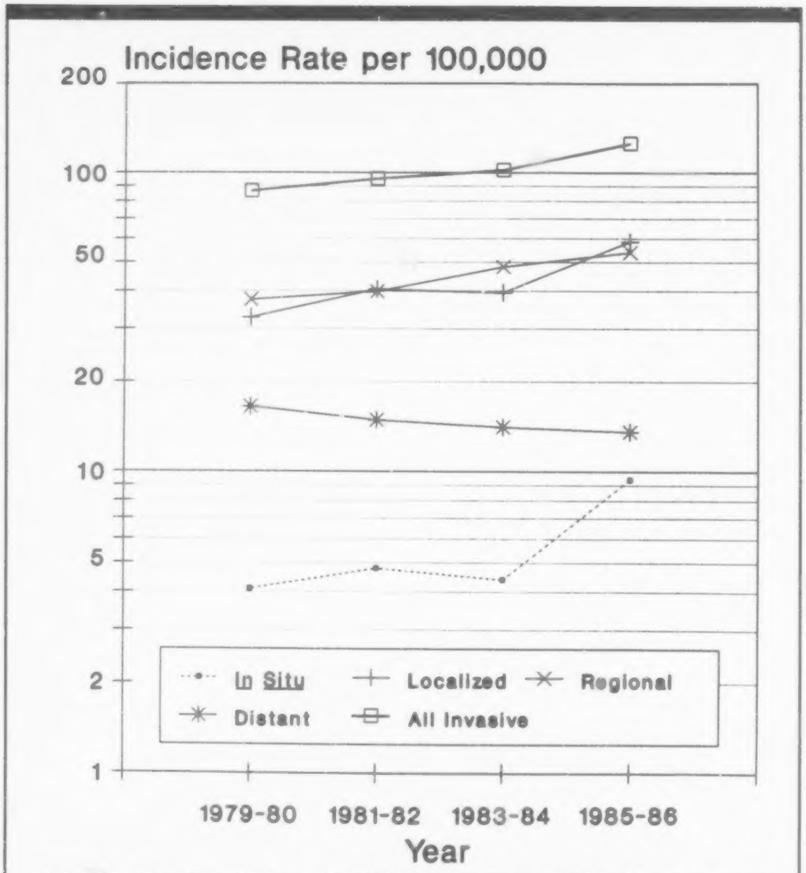

FIGURE 2—Trends over Time in Age-Adjusted Average Annual Incidence of Breast Carcinoma among Black Women in Atlanta, by Stage.

TABLE 2—Percentage Distribution of Reported Diagnostic Procedures and Stage for Sampled Patients in Atlanta, Stratified by Race and Time Period of Diagnosis

	White		Black	
Diagnostic method	1979–80	1985–86*	1979–80	1985–86*
Localized Stage				
Physical examination	3	1	2	2
Mammography	13	25	1	15
Both examination and mammogram	2	2	0	3
Neither	35	32	32	28
Nonlocalized Stage				
Physical examination	2	3	1	3
Mammography	4	12	3	4
Both examination and mammogram	0	1	0	0
Neither	41	24	61	44
Total	100 (n = 100)	100 (n = 99*)	100 (n = 100)	100 (n = 99*)

*One medical record could not be located.

Discussion

The findings of increasing incidence rates of both *in situ* and invasive breast carcinoma in Atlanta are consistent with results from national surveillance data.[4] Also in accord with national trends,[4] among women with invasive malignancies, only those with localized disease demonstrated a substantial rise in incidence.

Although improvement in case ascertainment could produce an apparent rise in incidence, case ascertainment procedures did not change over time, and less than one percent of cases throughout this study were detected only from death certificates, suggesting virtually complete ascertainment at hospitals.

It has been shown that an increasing proportion of ductal carcinomas of the breast are detected by mammograms at the *in situ* stage.[13] In principle, mammography could lead to the detection of invasive cancers that would not be recognized otherwise. In the present study, however, mammographic detection of asymptomatic lesions accounted for only 20–40 percent of rising incidence among Whites and only 13–25 percent among Blacks.

The impact of mammography on earlier diagnosis of breast cancer was evident, however. The proportion of localized invasive carcinomas rose among Whites and Blacks, and the sampled abstracts revealed shifts toward mammographic diagnoses for localized disease among both races. These findings are in agreement with the results of previous studies, which have shown smaller tumor size, fewer lymph node metastases,[19] and earlier stage at diagnosis[20] among women with breast cancer detected by mammography screening.

Factors other than mammography could have contributed to the shift toward earlier stages of disease. In particular, heightened awareness of breast cancer[4,21] and increasing practice of breast self-examination[21,22] could result in earlier recognition of disease. Unfortunately, the medical records reviewed in this study did not include information on these health behaviors.

In summary, it does not appear that increased mammographic screening fully accounted for the rising incidence of breast cancer. Further work is needed to determine whether increasing prevalence of established risk factors or the emergence of new risk factors can be implicated. ☐

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NIMH Fifth Annual Research Conference on Mental Disorders

The National Institute of Mental Health is planning a research conference on the classification, recognition and treatment of mental disorders in general health care settings serving children, adolescents, and adult patients. The conference, planned for September 23–24 in the Washington, DC vicinity, will be the fifth annual conference on this topic.

Research presentations are encouraged for special sessions on: 1) diagnosis and care of mental disorders in *special populations* (rural, minority, child/adolescent) who are served by general medical caregivers; and 2) *alcohol and substance use disorders* in general medical settings. Other topics of interest include:

- the classification and accuracy of mental and substance use disorder diagnoses;
- the recognition and management of mental and emotional disorders found in the chronically medical ill;
- the severely mentally ill in general health settings;
- effectiveness of pharmacologic, psychosocial or consultation-liaison services;
- patterns and outcomes of referral of general medical patients to mental health specialists.

Research treatment settings may include ambulatory primary care settings, medical/surgical inpatient services, nursing homes, and emergency wards.

Abstracts, due May 30, will be reviewed by a scientific advisory committee and NIMH staff. Priority will be given to abstracts on new, completed research. Work in progress with an expected completion date before the conference, and original reviews of the research literature, may also be submitted.

For further information or to request an abstract form, contact: Junius J. Gonzales, MD, or Kathryn Magruder, MPH, PhD, NIMH, Fifth annual Primary Care Research Conference, Room 18C13, 5600 Fishers Lane, Rockville, MD 20857; (301) 443-1330/3364.

The Validity of Health Risk Appraisals for Coronary Heart Disease: Results from a Randomized Field Trial

Kevin W. Smith, MA, Sonja M. McKinlay, PhD, and John B. McKinlay, PhD

ABSTRACT

Background: While health risk appraisals (HRAs) are becoming increasingly popular as tools for health assessment and health education, comparatively little is known about the accuracy of these risk estimates.

Methods: A field trial among 732 randomly selected adults ages 25 to 65 years was conducted to assess the validity of the risk scores produced by four widely used HRAs.

Results: Self-reported HRA risk scores for cigarette smoking and relative weight were generally accurate, but correlations between physiological measurements and scores for blood pressure, cholesterol, and physical activity were always lower than .51. Correlations between epidemiologic estimates of the probability of CHD death and HRA total risk scores ranged from .13 to .75; partial correlations adjusting for age, race, and gender ranged from .12 to .47.

Conclusions: The HRAs chosen for the field trial exhibited modest correlations with the CHD mortality risk predicted by the epidemiologic model. Mathematical errors made by respondents completing self-scored instruments and lack of knowledge regarding physiologic status decrease the accuracy of HRA risk estimates. (*Am J Public Health* 1991;81:466–470)

Introduction

Health risk appraisals (HRAs) are designed to estimate a person's mortality or morbidity risk for various diseases based on such characteristics as medical history, blood pressure, and smoking habits. HRAs have become increasingly popular as health education tools. Recent estimates indicate that more than 200 organizations in the United States currently use HRAs to promote health awareness, and that between five and 15 million people have completed one of these instruments.[1] HRAs are also frequently included in work-site health promotion activities.[2] Despite the burgeoning popularity of HRAs, comparatively little is known about the validity of the risk estimates produced by them. Several recent reviews of HRA usage have stressed the need for further research on the accuracy of the predictions made by these instruments.[3-5]

In an earlier paper,[6] we examined the accuracy of the scoring systems employed by 41 different HRAs to estimate coronary heart disease (CHD) mortality risk. Correlations between HRA risk scores and epidemiologic estimates were found to be influenced by the sophistication of the HRA scoring system, the number of risk factors included in the instrument, the range of categories available for each risk factor, and the sensitivity of the scoring system to the effects of age and gender. Foxman and Edington[7] have also examined HRA accuracy with respect to mortality from all causes. These two studies based their assessments of HRA accuracy on physical examinations in the Framingham Heart Study and Tecumseh Community Health Study, respectively. Since the respondents who complete HRAs may or may not be aware of the appropriate values for risk factors, the use of actual physiological measurements in these studies is likely to have overstated the accuracy that would be obtained from self-reported risk scores.

This paper examines HRA validity based on self-reported data from a general population. Three questions are addressed: 1) How accurate are respondents' self-reports for HRA risk factors? 2) How accurate are HRA estimates of the risk of CHD mortality based on these self-reports? 3) To what extent is the validity of HRA risk scores affected by reporting errors and computational mistakes made by respondents?

Methods

A field trial of health risk appraisal instruments was conducted by the Cambridge Research Center of the American Institutes for Research in 1987. The trial was specifically designed to assess the reliability and validity of four representative HRAs in a general population. Respondents between the ages of 25 and 65 were identified through random digit dialing of 15 telephone exchanges in the Boston metropolitan area. Sampling and interviewing procedures for the field trial have been described elsewhere.[8]

During home visits, trained field technicians administered a standardized per-

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TABLE 1—Risk Score Ranges by HRA

	Arizona Heart Institute	CDC	Determine Your Medical Age	RISKO
Heart Attack Risk	0–50	2–21,989	—	0–27
Appraised Age	—	—	12.0–70.6	—
Smoking	0–10	.8–2.1	−6–24	−2–4
Relative Weight	0–3	.8–1.6	−6–24	−2–3
Blood Pressure	0–6	.4–1.1	0–12	−5–6
Cholesterol	—	.5–1.6	0–6	−3–3
Physical Activity	0–3	.6–2.5	−12–12	—

TABLE 2—Validation Measures for Risk Items and for Total Risk Scores

Self-Reported Risk Factors	Validation Measure
Blood Pressure	2nd Sphygmomanometer Reading (mmHg)
Total Serum Cholesterol	Laboratory Lipid Analysis (mg/dl)
Physical Activity	Harvard Alumni Activity Survey Scale (natural log of kcal expenditure for previous week)
Relative Weight	Quetelet Index (kg/m^2)
Smoking	Cigarettes per Day
Heart Attack Risk Appraised Age	NHANES I Epidemiologic Followup: CHD mortality risk estimate

sonal interview and one of the four HRAs to be evaluated by the project. Technicians were instructed not to help respondents complete HRA items or compute risk scores. The technician also measured blood pressure, height, and weight, and drew a venous blood sample for cholesterol analysis following the protocol established by the Centers for Disease Control (CDC). In-home physiological measurements have been shown to be as reliable and valid as those performed in a central location using standard equipment.[9]

Four widely used HRAs were chosen to represent the major types of computer-scored and self-scored instruments available in 1987: 1) Health Risk Appraisal (Centers for Disease Control), 2) The Heart Test (Arizona Heart Institute), 3) RISKO (American Heart Association), and 4) Determine Your Medical Age (Blue Cross/Blue Shield of New York). These were found to be among the most valid instruments within major HRA classifications in our previous work.[6] Since the field trial, the CDC instrument has been replaced by the Carter Center's "Healthier People" HRA.[10] The Carter Center's questionnaire and reporting format are similar to those of the earlier CDC version, but it uses an updated algorithm for assessing risk.

Each instrument requires a respondent to select categories that best describe personal habits, physiological status, and medical history. Point values or weights associated with these categories are then combined to produce an overall estimate of risk. In these four HRAs, total risk is summarized either by a heart-attack risk scale, with higher values representing greater risk, or by appraised age. Appraised age is the age at which the average mortality risk for all adults of the same gender and race is equal to the risk projected for a particular individual. If a person's appraised age is higher than his chronological age, that person has a greater than average chance of dying. The range of total risk scores and point values or weights for five major CHD risk items is shown in Table 1.

The CDC HRA, which requires computer processing, provides probability estimates for the 12 leading causes of death based on the Geller-Gesner method.[11] The Arizona Heart Institute's Heart Test and RISKO are self-scored instruments focusing on heart attack risk. In Determine Your Medical Age, appraised age is calculated by adjusting an individual's chronological age for medical history and lifestyle factors.

A standard psychometric definition for validity was adopted for this study; that is, that validity refers to the degree to which an instrument measures what it is intended to measure.[12,13] In order to assess the validity of a measure, some criterion or "gold standard" must be available for comparison. Table 2 shows the validation measures used in this study. Physiological values served as standards for three of the five CHD risk items. The standards for physical activity (kilocalorie expenditure for the previous week as calculated from the Harvard Alumni Activity Survey Scale)[14] and cigarette smoking were based on self-reports collected during personal interviews. HRA scores for heart attack risk or appraised age were compared to estimates from the NHANES I Epidemiologic Followup Study (NHEFS).[15] Separate NHEFS logistic models for men and women provide estimates of the probability of death due to coronary heart disease over a ten-year period based on a large (N = 4,013) representative sample of white adults.

Several statistical techniques can be employed to assess the extent of agreement or conformity between two measurements, including sensitivity, specificity, correlations, mean differences, and standard deviations for differences. Which technique is most appropriate remains a controversial issue.[16,17] However, the self-reported risk scores and the validation measures in this study cannot be directly compared because they were not measured on the same scale. Therefore, product-moment correlations between risk scores and validation measures were employed as the primary indicator of accuracy.[12]

As the criterion measure for CHD risk, the 10-year heart disease mortality probability for each respondent was calculated using the gender-specific NHEFS models. Physiological measures taken by field technicians, rather than self-reports, were used to make the logistic estimates as accurate as possible. According to the logistic models, a few respondents had mortality risks that were much higher than the risks for the great majority of cases. To prevent these outliers from distorting the correlation coefficients, the natural logarithm of the 10-year mortality risk per 100,000 persons was used in the analyses.

Three HRA total risk scores were computed for each respondent: 1) the score reported by the respondent, 2) the risk score corrected for mathematical errors, and 3) the score that would have been obtained on the basis of the blood pressure, cholesterol, height, and weight measurements taken by field technicians. The first of these scores does not apply to the CDC instrument, which is calculated by computer. Each of these three risk scores was then correlated with the log-

TABLE 3—Demographic Characteristics of Field Trial Participants and Nonparticipants*

Characteristics	Participants		Nonparticipants (n = 544)
	Physiologic Status Measured at Baseline (N = 309)	Physiologic Status Measured at Follow-up (N = 423)	
Age (years)	39.8 (10.7)	38.9 (10.6)	40.2 (11.1)
Percent female	59.9 (49.1)	56.0 (49.7)	60.5 (48.9)
Percent Black/Hispanic	11.0 (31.4)	6.7 (24.9)	8.2 (27.4)
Income (thousands)†	41.4 (11.3)	41.0 (10.3)	40.5 (10.1)
Self-reported health status**	1.94 (.87)	2.04 (.94)	2.06 (.91)
Worry about health††	2.56 (.84)	2.53 (.84)	2.52 (.84)

*Mean and (standard deviation)
†Mean household income in subject's telephone exchange
**Five-point scale; 1 = excellent, 5 = poor
††Four-point scale; 1 = not at all, 4 = most of the time

transformed probability estimates derived from the NHEFS logistic model. Logarithmic transformations were also applied to the CDC probabilities. CHD mortality rates increase monotonically with age and are considerably higher for men than women. To remove these effects from the validity assessments, partial correlations were also computed for each HRA score, adjusting for age, gender, and race.

Results

Baseline interviews were completed by 732 of 1,276 eligible adults (57.4 percent) contacted for the field trial. A logistic regression analysis of response rates indicated that the probability of obtaining a completed interview was not affected by demographic characteristics (gender, race, age, and average income level in the telephone exchange), self-reported health status, or concern about the state of one's health. Similarities between field trial participants and eligible subjects who declined to be interviewed are shown in Table 3. The median age of the sample was 38 years. Respondents were somewhat younger and healthier than the general population because persons with diabetes, hypertension, or evidence of overt cardiovascular disease were screened out of the sample.

Validity of CHD Risk Factors

The first set of analyses focused on five specific CHD risk items. These analyses were restricted to respondents whose physiological measurements were completed during the baseline interview. Table 4 shows the correlations between self-reported risk scores and validation measures for each of the four HRAs. These results reveal some sharp distinctions among the individual risk factors. The coefficients for cigarette smoking and relative weight were always .6 or greater for each of the four instruments. On the other hand, none of the correlations for physical activity, blood pressure, or cholesterol were higher than .5. The HRA risk scores for these items accounted for less than 25 percent of the variance in the physiological measures. The smallest correlations were found for blood pressure and cholesterol. This occurs primarily because many people do not know the appropriate values and either assume that their levels are average or make inaccurate guesses. The magnitudes of these correlations were relatively consistent from HRA to HRA; there was more variation among different risk factors than among instruments.

Validity of Heart Attack Risk Scores and Appraised Age

The second set of analyses examined the validity of HRA scores for heart attack risk and appraised age. There are two potential sources of error in total risk scores. First, respondents may be unaware of the appropriate values for physiological measures. When asked to specify exact values during in-person interviews, only 27 percent of the respondents gave systolic blood pressure values within 10 mmHg of those recorded by the field technicians, and only 4 percent estimated their total serum cholesterol to within 20 mg/dl of laboratory readings.

For self-scored appraisal instruments, a second source of error lies in computational mistakes made by respondents when calculating their total risk scores. Many of the field trial participants had difficulty computing these scores (Table 5). Error rates were affected both by the mathematical skills required by each instrument (addition, subtraction, or division) and by respondents' educational attainment (persons without four-year college degrees were twice as likely to make mistakes as those with baccalaureate or advanced degrees).

To assess the effects of these potential sources of error, separate correlations were computed for the risk scores reported by respondents, scores corrected for mathematical errors, and the scores that would have resulted from the physiological measurements taken by field technicians. The last of these three scores is similar to estimates based on physical examination data evaluated in our previous study.[6]

The upper panel of Table 6 shows the correlations for each HRA based on all respondents who were able to calculate risk scores and had a complete set of physiological measurements. The CDC risk appraisal had the highest correlations. This computerized instrument uses a more sophisticated scoring algorithm than the other HRAs and was the only one of the four that, like the logistic models, provides probability estimates for CHD mortality over a ten-year period. The CDC estimates, however, were consistently higher than the risks predicted by the NHEFS models (average risks of 1,522 per 100,000 compared with 1,173 per 100,000). Determine Your Medical Age had the next highest set of correlations, even though this instrument is not designed specifically for heart disease. Mathematical errors played an important role in the validity of this HRA, as the average coefficient increased from .41 to .55 when respondents' mistakes were corrected. Determine Your Medical Age also benefits considerably from the fact that CHD risk increases greatly with age, so that any HRA based on appraised age should have a reasonably high correlation in this type of analysis.

The pattern of results was considerably different for the Arizona Heart Institute HRA than for the other instruments. The correlations for this HRA were always about .52, regardless of whether computational errors were corrected or actual physiological values were substituted for the respondent's choices. This probably occurred because comparatively few people completing this instrument made errors in their risk calculations and because cholesterol values are not re-

TABLE 4—Correlations (and 95 Percent Confidence Intervals) between Validation Measures and Risk Item Scores

	Arizona Heart Institute (N = 67–68)		CDC (N = 63–77)		Determine Your Medical Age (N = 64–70)		RISKO (N = 55–64)	
Risk Items	r	95% CI	r	95% CI	r	95% CI	r	95% CI
Cigarettes Smoked per Day	.85	(.77–.91)	.66	(.52–.77)	.75	(.62–.84)	.80	(.69–.88)
Relative Weight	.74	(.61–.84)	.86	(.79–.91)	.64	(.47–.76)	.70	(.55–.81)
Physical Activity	–.27	(–.48 to –.04)	–.48	(–.64 to –.28)	–.47	(–.64 to –.26)	—	—
Systolic Blood Pressure	.47	(.26–.64)	.36	(.14–.54)	.00	(–.23–.24)	.50	(.29–.67)
Total Serum Cholesterol	—	—	.40	(.17–.59)	.18	(–.06–.41)	.26	(.00–.49)

TABLE 5—Percentage of Baseline Respondents Making Computational Errors When Calculating HRA Risk Scores

	Arizona Heart Institute (N = 157)	Determine Your Medical Age (N = 170)	RISKO (N = 155)
Score computed correctly	86.6	41.8	74.8
Score computed incorrectly	7.0	32.9	14.2
Could not compute score	6.4	25.3	11.0
Totals	100%	100%	100%

TABLE 6—Correlations between HRA Risk Scores and Natural Logarithm of NHEFS Ten-year CHD Mortality Risk Estimates

	Arizona Heart Institute (N = 124)	CDC (N = 137)	Determine Your Medical Age (N = 104)	RISKO (N = 112)
Zero-order correlations:				
Self-reported	.52	—	.41	.13
Corrected for errors	.52	.75	.55	.09
Physiologic field measures	.52	.77	.56	.40
R^2 for NHEFS estimate regressed on sex, age, and race	.85	.90	.87	.86
Partial correlations*:				
Self-reported	.42	—	.12	.19
Corrected for errors	.39	.47	.42	.39
Physiologic field measures	.39	.51	.43	.68

*Adjusted for respondent's gender, age, and race.

quired. RISKO had the smallest correlation with logistic estimates for the scores reported by respondents (.13), but in contrast to the other three HRAs, RISKO scores represent relative rather than absolute mortality risk.

A more refined assessment of validity can be made by examining partial correlations between HRA scores and the logistic estimates after controlling for age, gender, and race, as shown in the lower panel of Table 6. These three demographic characteristics consistently explained 85 to 90 percent of the variation in the log-transformed logistic rates. The resulting partial correlations were smaller than the unadjusted correlations in Table 5 for all HRAs except RISKO. The partials for self-reported Medical Age and RISKO scores were less than .2, but these coefficients more than doubled when mathematical errors were corrected. The magnitudes of the partial correlations also showed small improvements for three HRAs and a large increase for RISKO when physiological measurements taken in the field were substituted for the values selected by respondents.

Discussion

The results of this randomized field trial have several important implications for the accuracy of HRA instruments when used by a general population.

First, self-reported risk scores for cigarette smoking and relative weight appear to be accurate enough for use in HRAs. However, reports for physical activity, blood pressure, and cholesterol were frequently inaccurate when compared with more objective measures. Many people don't know their blood pressure or cholesterol levels and don't do a very good job of guessing what these values are. In the field trial, 27 percent of the sample reported systolic blood pressure values that were within 10 mmHg of the readings taken by field technicians and only 4 percent gave cholesterol values that were within 20 mg/dl.

The HRAs chosen for the field trial exhibited modest correlations with the CHD mortality risk estimates predicted by the NHEFS epidemiologic model. After adjusting for variations attributable to age, gender, and race, the partial correlations for all three of the self-scored instruments were approximately .4 when computational errors had been corrected. The partial correlation for the CDC HRA, the only instrument that produced probability estimates, was only slightly higher (.47). Moreover, like other HRAs based on the Geller-Gesner techniques, CDC's ten-year mortality risk predictions were consistently higher than those produced by the NHEFS data.[6,7] Several of the more recently developed HRAs incorporate logistic equations that may be expected to yield higher partial correlations than the field trial instruments.

The trial results also indicate that, when used in the field, the accuracy of the self-scored HRAs is attenuated by mathematical errors made by respondents and, to a lesser extent, by a lack of knowledge of the exact values for blood pressure, cholesterol, height, and weight. Computational errors substantially reduced the correlations for RISKO and Determine Your Medical Age, but not for the Arizona

Heart Institute instrument. This appears to be a function of the computational burden a self-scored HRA imposes on respondents. Determine Your Medical Age requires three mathematical operations (addition, subtraction, and division); RISKO, two (addition and subtraction), while the Arizona Heart Institute scores involve only addition. Computational errors and uncertainty regarding one's physiological status have also been found to lower the test-retest reliability of these HRAs.[8] Providing respondents with accurate physiological measurements and checking HRA calculations for errors will therefore improve both the reliability and the validity of self-scored risk estimates.

Finally, it should be noted that the analyses presented in this paper are restricted to CHD mortality. Since the risk factors for CHD are relatively well established, HRA risk estimates may be less accurate for other, less frequent causes of death and morbidity. □

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Clinical and Epidemiological Features of Neurotoxic Shellfish Poisoning in North Carolina

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ABSTRACT

Background: In October 1987, a red tide due to *P. brevis* affected the North Carolina coast for the first time. The purpose of our study was to describe the clinical and epidemiological features of neurotoxic shellfish poisoning (NSP), an illness caused by eating shellfish contaminated with the neurotoxins of *P. brevis.*

Methods: Active surveillance was established for cases of NSP. A descriptive study of the NSP cases was then completed.

Results: Forty-eight persons, who had eaten oysters at 20 meals, met the case definition. A variety of gastrointestinal tract and neurological symptoms were reported. The illnesses were generally mild and of short duration, and there were no deaths. Forty-one (85 percent) affected persons lived in five communities located within a 70-kilometer area along the coast. Cases occurred from October 27 to December 9; 27 (56 percent) of the cases occurred before the first closure of affected shellfish waters on November 2. There was a significant increase in the illness attack rate with an increase in the number of oysters eaten.

Conclusions: Routine monitoring of coastal waters for *P. brevis* is needed to facilitate earlier recognition of red tides, closure of affected areas, and education of the public before substantial exposure to contaminated shellfish occurs. (*Am J Public Health* 1991;81:471–474)

Introduction

Neurotoxic shellfish poisoning (NSP) is an unusual syndrome characterized by paresthesia, reversal of hot and cold temperature sensation, myalgia, vertigo, and ataxia.[1–5] Other symptoms include abdominal pain, nausea, diarrhea, burning pain in the rectum, headache, bradycardia, and dilated pupils.[1–5] It is caused by eating filter-feeding shellfish (oysters, clams, coquinas, and other bivalve mollusks)[5] containing neurotoxins produced by the marine dinoflagellate, *Ptychodiscus brevis*[6] (formerly *Gymnodinium breve*[7]). Accumulation of neurotoxins in fish probably does not occur.[5]

P. brevis can also cause a respiratory irritation syndrome.[8] The dinoflagellates are easily lysed by the surf, releasing toxins that cause conjunctival irritation, rhinorrhea, and nonproductive cough in persons who are close to the water.

The health problems caused by *P. brevis* are associated with a red tide bloom.[3,4,8] Red tide is a discoloration of sea water caused by a proliferation of large numbers of dinoflagellates.[8] In late October 1987, the North Carolina coast was affected by a *P. brevis* red tide, the first such episode outside of Florida and Texas.[9] The source of the dinoflagellates was probably a red tide that occurred off the southwest coast of Florida in September. The organism was carried around Florida by the Florida current and then north along the east coast of Florida by the Gulf Stream. In late October, a strong inshore eddy of the Gulf Stream, later detected using satellite imagery, probably brought algae-laden water to the North Carolina coast. Under favorable reproductive conditions, the organism proliferated, resulting in an extensive red tide. By October 30, the characteristic discoloration, massive fish kills, and cases of the respiratory irritation syndrome were reported along the North Carolina coast. On November 2, the organism was identified, and the affected shellfish areas were closed. On November 4, the first official news release warned the public not to consume shellfish from affected areas.

In early November, the Environmental Epidemiology Section of the North Carolina Department of Environment, Health, and Natural Resources learned of several neurological illnesses that occurred following consumption of shellfish harvested from known red-tide-affected waters. To detect other possible cases of NSP in North Carolina, active surveillance was established. In this report, we describe the general clinical and epidemiological features of NSP cases detected in this manner.

Methods

Telephone contact was made with coastal county primary-care physicians, health departments, and emergency rooms; emergency rooms in referral hospitals for the coastal counties; and the

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TABLE 1—Symptoms of 48 Neurotoxic Shellfish Poisoning Cases, North Carolina, 1987

Symptom	N (%) of Patients with Symptom	Median Time between Eating Shellfish and Onset Hr. (Range)	Median Duration Hr. (Range)
Gastrointestinal			
Abdominal pain	23 (48)	5 (1–18)	17 (1–48)
Nausea	21 (44)	3 (0.5–18)	18 (1–48)
Diarrhea	16 (33)	10 (1–18)	17 (2–48)
Vomiting	5 (10)	3 (1–15)	8 (0.5–48)
Neurological: sensation			
Paresthesia	39 (81)	4 (0.25–14)	8 (0.5–51)
Temperature reversal	8 (17)	7 (0.25–16)	8 (1–26)
Myalgia	6 (13)	6 (0.5–13)	7 (2–24)
Neurological: cerebellum			
Vertigo	29 (60)	3 (0.25–17)	16 (0.5–72)
Ataxia	13 (27)	3 (0.25–14)	7 (0.5–40)
Tremor	3 (6)	3 (0.25–10)	5 (0.5–9)
Neurological: motor			
Weakness	15 (31)	3 (0.25–17)	24 (0.5–51)
Systemic			
Malaise	24 (50)	3 (0.25–15)	24 (2–72)
Chills	10 (21)	2 (2–8)	11 (2–48)
Headache	7 (15)	2 (0.5–12)	7 (2–24)

North Carolina Division of Marine Fisheries. Each facility was asked to report any neurological or gastrointestinal (GI) illnesses associated with the consumption of shellfish after October 23 (when the toxic dinoflagellate probably first arrived on shore). Telephone interviews were completed on persons reported through surveillance and persons identified by the surveillance cases who had eaten at the same shellfish meals. The following data were sought from each person: name; age; sex; race; weight; presence of a chronic illness; medication use; date, time, and location of harvest or purchase of shellfish; type of preparation of shellfish; date and time shellfish were eaten; type and amount of shellfish consumed; time of onset of symptoms; estimates of duration of symptoms; estimates of days of bed rest and days lost from work or school; when and where medical attention was sought; and type of medical treatment. The questionnaire included a list of symptoms previously associated with NSP.[2] In addition, the questionnaire included symptoms associated with two similar toxic dinoflagellate syndromes—paralytic shellfish poisoning and ciguatera fish poisoning.[2]

Shellfish (oysters, clams, or mussels) were considered toxic if they produced at least one case of illness characterized by any of the previously reported neurological symptoms of NSP—paresthesia, temperature sensation reversal, myalgia, vertigo, or ataxia. In addition, shellfish must have been harvested from a known red-tide-affected area (>5000 *P. brevis* organisms/liter of water detected by direct microscopic examination). A person who had eaten toxic shellfish was defined as a case if any of the previously reported neurological symptoms of NSP occurred within 24 hours of eating the shellfish and persisted for at least one hour.

A retrospective cohort analysis was completed on those persons who had eaten at toxic shellfish (oyster) meals. Fisher's exact test was used to compare illness attack rates in those exposed and unexposed to toxic oysters.[10] Among persons who had eaten toxic oysters, summary 95 percent confidence intervals were used to assess the effect of potential risk factors (number of shellfish eaten, age, sex, presence of a chronic illness, chronic use of a medication, or alcohol consumption with the meal) on the attack rate of NSP.[11] The Mantel-Haenszel chi-square test for trend was used to assess the change in attack rates with an increase in the number of shellfish eaten.[12]

Residual specimens of toxic oysters were collected whenever available for laboratory analysis by the Environmental Sciences Section, Division of Laboratory Services, of the Department. Shellfish specimens harvested from the same general areas as those that were eaten at all the other shellfish meals were also collected for analysis. Since a bioassay specific for *P. brevis* neurotoxins was not available, a standardized mouse bioassay was used on the specimens to test for the presence of neurotoxicity.[13] This bioassay is based on the time until death of mice injected intraperitoneally with crude toxin residues extracted from shellfish. Relative toxicity is expressed in mouse units (MU). One mouse unit is the amount of crude toxin residue that, on average, will kill 50 percent of test mice in 930 minutes. Any detectable level of toxin per 100 grams of shellfish meat was considered a positive test.

Results

Forty-eight persons, who had eaten at 20 different meals, met the case definition. Two other persons experienced several of the typical NSP neurological symptoms after eating oysters in two different restaurants, but they were excluded from analysis because shellfish harvest sites could not be determined.

The median incubation period was three hours (range, 15 minutes to 18 hours). GI and neurological symptoms tended to occur at the same time. The constellation of symptoms presented by the cases is shown in Table 1. Forty-five (94 percent) had multiple symptoms, and 34 (71 percent) had more than one neurological symptom. There were no instances of paralysis or respiratory arrest. However, a 43-year-old White female was admitted to an intensive care unit for severe symptoms of bilateral carpopedal tremor and myalgia; total body paresthesia; ataxia; and vertigo. These symptoms developed 9.5 hours after eating approximately 45 oysters. On neurologic examination, her physician found decreased sensation, decreased reflexes, and temperature reversal in both lower extremities. She was treated supportively and recovered completely, approximately nine hours after onset of illness.

The median duration of illness was 17 hours (range, one to 72 hours). Twelve affected persons (25 percent) required one day of bed rest, while only one required two days of bed rest. Six (12.5 percent) missed one day of either work or school. One patient was hospitalized, but there were no deaths.

The 48 affected persons had a median age of 43 years (range, nine to 66 years); 27 (56 percent) were male, and all were white. Forty-one of the affected persons (85 percent) lived in five communities located along a 70-kilometer coastal area in Carteret and Onslow counties. This was the first area to be affected by the red tide, and it consistently had some of the highest *P. brevis* cell concentrations throughout the bloom. Cases occurred from October 27 to December 9 and peaked on Novem-

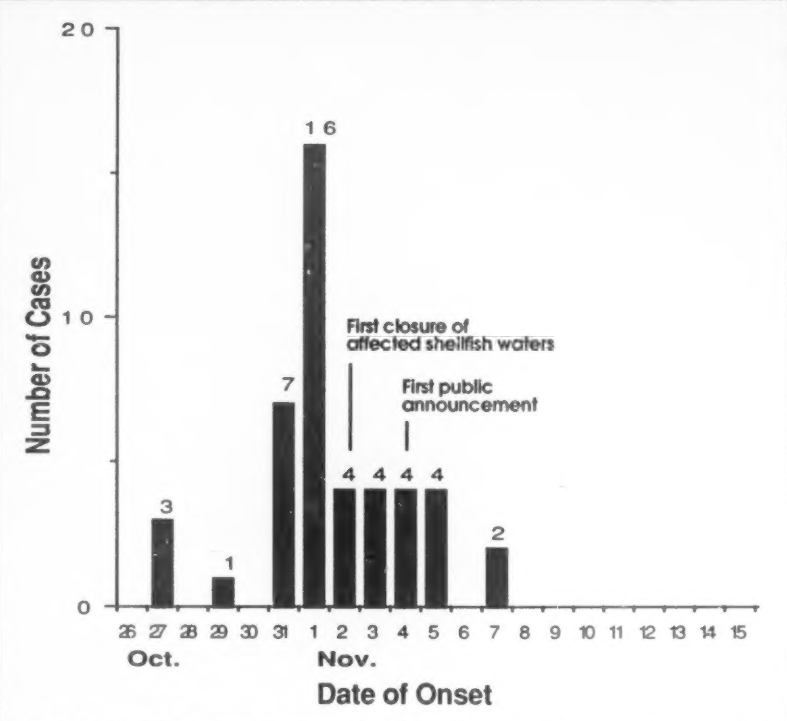

FIGURE 1—Date of Illness Onset, for 48 Neurotoxic Shellfish Poisoning Cases, North Carolina, 1987.

ber 1 (Figure 1). Three additional persons (not shown in figure) had eaten oysters harvested on October 31 and kept frozen until the date of the meal, December 8, when they became ill. Twenty-seven of the cases (56 percent) occurred before the first shellfish water closure on November 2.

All of the shellfish eaten at the meals were harvested within the same 70-kilometer stretch of coast discussed above. Forty-four of the affected persons (92 percent) had eaten shellfish harvested either by themselves or by another individual (relative, friend, or neighbor); whereas four (8 percent) had purchased oysters from fish markets. Two of the four had purchased oysters from a market before the shellfish harvest ban and the first public news release; the remaining two had purchased oysters from a fish market shortly after the ban and the news release.

Oysters were the only shellfish eaten at 19 of the 20 meals, while both oysters and clams were eaten at one meal. All cases were associated with freshly harvested shellfish, except for the one instance in December where frozen oysters were consumed. The shellfish consumed were generally described as being normal in appearance, taste, and smell. In all but one instance, the shellfish had been cooked before eating; cooking methods included steaming, roasting, baking, boiling, and frying.

A total of 98 persons had attended the 20 shellfish meals. The retrospective cohort analysis of these 98 persons revealed an illness attack rate of 56 percent (48/85) among those who had eaten oysters; none of the 13 persons who had not eaten shellfish became ill. None of the 25 case household members, who were not present at the shellfish meals, developed neurological or GI illnesses suggestive of NSP. Among those who had eaten oysters, the number of shellfish eaten was the only potential risk factor examined that significantly influenced the attack rate of NSP. The risk of developing NSP increased with the number of oysters eaten; this trend in disease risk was statistically significant (Table 2). The attack rates and relative risks in Table 2 were essentially unchanged after adjusting for age and the other potential risk factors examined in this study. Thus, only unadjusted data are shown in Table 2.

Samples of oysters eaten by four affected persons from two meals tested positive for *P. brevis* neurotoxins (35 and 60 MU, respectively). Samples of oysters harvested from the same general areas as those that were eaten by all the other cases also tested positive (mean, 62 MU; range, 48–170 MU).

Discussion

Since it was not possible to confirm the NSP cases with a specific laboratory test, some of the reported illnesses may have been due to other causes. However, this possibility was minimized by using a specific case definition—illness typical of previously reported NSP after eating shellfish harvested from a known red tide-affected area. In addition, epidemiological findings support the conclusion that the illnesses reported were due to NSP. First, none of the reporting sources were aware of any increase in neurological or GI illnesses unrelated to shellfish consumption during the time of the red tide bloom. Second, none of the 13 persons who had not eaten shellfish at any of the 20 meals developed neurological or GI symptoms suggestive of NSP. Third, none of the 25 case household members who were not present at the shellfish meals developed illnesses suggestive of NSP. Finally, among those who had eaten oysters, the illness attack rate rose with the number of oysters eaten. In addition to this epidemiological evidence, sample oysters tested positive for *P. brevis* neurotoxins, using the mouse bioassay.[13]

The affected persons developed a variety of neurological and GI symptoms similar to NSP cases previously reported from Florida.[3,4] However, we did find differences in the North Carolina cases that could provide insight in future clinical evaluations. Nausea and vertigo were more common in North Carolina than in Florida. In addition, some symptoms reported in North Carolina were not mentioned in the Florida reports; these included malaise, muscle weakness, tremor, and a choking sensation or throat tightness (this symptom was not included on the questionnaire but was spontaneously reported by several persons). Finally, 21 of the North Carolina cases (44 percent) had latency periods greater than three hours; whereas in Florida, all NSP cases had latency periods of less than three hours. These longer latency periods may have been due to differences in the relative concentrations of *P. brevis* neurotoxins. Indeed, analysis of neurotoxins from water samples taken during the North Carolina red tide bloom demonstrated a greater proportion of a slower acting component than had been found in a previous Florida red tide.[14]

TABLE 2—Number of Oysters and Risk of Neurotoxic Shellfish Poisoning, for Those Who Consumed Oysters, North Carolina, 1987

Number of Oysters	Cases	Total	AR (%)*	RR	95% CI
<12	2	15	13.3	1.0	
12–35	16	30	53.3	4.0	1.1–15.2
≥36	29	39	74.4	5.6	1.5–20.5

*AR = Attack Rate
Mantel-Haenszel chi-square = 15.9 p <0.000034

Even though *P. brevis* was detected in shellfish waters until mid-February 1988, the number of cases dropped sharply on November 2, suggesting that the shellfish water closure and public news release were effective in preventing illness. Most of the cases occurred among persons who had eaten oysters harvested either by themselves or by a relative or friend, emphasizing the need to educate not only seafood merchants but also the general public about the dangers of harvesting and consuming shellfish from red tide-affected waters. Furthermore, most of the NSP cases lived along that section of the coast where the bloom started and where *P. brevis* reached its highest concentrations. These persons had easier access to toxic oysters, which is possibly the cause of this geographic clustering. It is therefore important to focus education measures on populations of coastal areas directly affected by red tide waters.

The effectiveness of shellfish water closures and public education as preventive measures depends on early detection of *P. brevis* in water samples. In North Carolina, more than a week passed from the time dinoflagellate cells were first carried to the coast until the first shellfish water closure and public news release. The characteristic discoloration of water, fish kills, and the respiratory irritation syndrome indicate the presence of a red tide and possible shellfish contamination and are thus useful warning signs. However, Florida officials, by routinely sampling coastal waters during the months when red tides tend to be more common, can usually detect levels of the organism high enough to contaminate shellfish (>5,000 organisms/liter of water), but not yet high enough to cause noticeable effects in the water (Florida Department of Natural Resources contingency plan for control of shellfish potentially contaminated by marine biotoxins. Bureau of Marine Research, St. Petersburg, Florida, 1985). This probably prevents cases of NSP.

Routine monitoring of coastal waters has now been established in North Carolina. The Gulf Stream is checked for inshore incursions or eddies by examining oceanographic frontal analyses received from the National Hurricane Center in Miami. These analyses are prepared thrice weekly from hourly infrared images taken by the Geostationary Operational Environmental Satellite series. These analyses are normally used to assist mariners who wish to either utilize or avoid the swiftly flowing Gulf Stream. Fishermen also use the analyses to pinpoint potentially good fishing areas. If a strong eddy occurs along the North Carolina coast, then sampling of relevant coastal waters for *P. brevis* is started immediately. Such a monitoring program should facilitate earlier recognition of possible future red tides, closure of affected areas, and education of the public before substantial exposure to contaminated shellfish occurs. ☐

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Bone Cancer Incidence Rates in New York State: Time Trends and Fluoridated Drinking Water

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ABSTRACT

Background: Recent animal studies of the potential carcinogenicity of fluoride prompted an examination of bone cancer incidence rates.

Methods: Trends in the incidence of primary bone cancers, including the incidence of osteosarcomas were examined among residents of New York State, exclusive of New York City. Average annual osteosarcoma incidence rates in fluoridated and non-fluoridated areas were also compared.

Results: Among persons less than 30 years of age at diagnosis, bone cancer incidence among males demonstrated a significant increase since 1955, while incidence among females has remained unchanged. A significant decrease in bone cancer incidence rates since 1955 was observed among both males and females age 30 years and over at time of diagnosis. Osteosarcoma incidence rates have remained essentially unchanged since 1970, among both younger and older males and females. The average annual age adjusted incidence of osteosarcomas (1976–1987) in areas served by fluoridated water supplies was not found to differ from osteosarcoma incidence rates in non-fluoridated areas.

Conclusions: These data do not support an association between fluoride in drinking water and the occurrence of cancer of the bone. (*Am J Public Health* 1991;81:475–479)

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Introduction

Artificial fluoridation of public drinking supplies has resulted in an ongoing debate concerning the potential health effects of this practice. Proponents have emphasized the benefits to dental health from the artificial fluoridation of drinking water, while opponents have suggested that a variety of adverse health outcomes, including cancer, can result from this exposure.

Interest in the potential carcinogenicity of fluoride has resurfaced as a result of recently released findings from a National Toxicology Program (NTP) study of rodents with life-long exposures to fluoride. That study reported an increased incidence of osteosarcomas among male rats ingesting a high fluoride diet. Although the significance of these findings is unclear, the study has raised renewed questions about the association between fluoridated drinking water and bone cancers, particularly osteosarcomas, in human populations.

Several studies which have compared cancer mortality in fluoridated and non-fluoridated areas have determined that cancer mortality is unrelated to fluoride levels in drinking water.[1–6] However, the relationship between cancer incidence and fluoridated water has not been thoroughly examined. We were able to identify only two previous studies of cancer incidence and fluoridated water supplies.[1,7] Using data from the Second and Third National Cancer Surveys, Hoover *et al*,[1] compared cancer incidence for a fluoridated (Denver) and nonfluoridated metropolitan area (Birmingham). No significant differences in overall cancer incidence were apparent, nor were significant differences in bone cancer incidence observed. Kinlen and colleagues[7] reported no differences in the incidence of bone cancers among areas in England and Wales, and the United States, Holland, and New Zealand, with high and low fluoride levels in drinking water. An additional study of exposure to fluoride among an occupational cohort reported an elevated cancer incidence among exposed workers, attributable to an excess of respiratory cancers.[8] It is not possible to rule out smoking as the cause of this respiratory cancer excess since information on smoking histories was unavailable. No cases of bone cancer were reported in this study of occupational fluoride exposure.

Widespread artificial fluoridation of drinking water supplies in New York State began primarily during the 1950s and early 1960s. By analyzing data in the New York State Cancer Registry, it is possible to compare current bone cancer incidence rates with rates prior to widespread fluoridation. This paper presents data on time trends in bone cancer incidence, including the incidence of osteosarcomas, among residents of New York State, exclusive of New York City, and compares average annual osteosarcoma incidence rates in fluoridated and nonfluoridated areas.

Methods

The New York State Cancer Registry has been operational since 1940, when

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cancer became a reportable disease in NYS. Beginning in 1973, this population-based registry expanded coverage to include the New York City area, thereby encompassing all of NYS. While physicians, laboratories, and hospitals are required to report cancer cases, most cases in the NYS Cancer Registry and other cancer registries are reported by hospital tumor registrars and medical record administrators. Based on the results of special studies of hospital records, it is estimated that over 95 percent of all cancer cases in New York State, exclusive of New York City, are reported to the registry.[9]

Analyses were restricted to primary malignancies of the bone occurring among residents of New York State, exclusive of New York City, between 1955 and 1987. The New York City area was excluded due to lack of cancer data before 1973. Bone malignancies were coded to International Classification of Diseases, Ninth Revision (ICD-9),[10] site 170. Site 170 includes cancers of the bone and articular cartilage, but excludes carcinomas of any type other than intraosseous or odontogenic. Three separate comparisons of bone cancer incidence were undertaken.

The first comparison involved the calculation of average annual age-specific bone cancer incidence rates, between 1950 and 1987, for both males and females. Because of the distinct bimodal age pattern for bone cancers,[11] incidence rates were compared within two broad age categories: less than 30 years and 30 years and older at time of diagnosis. United States Census data were used to provide decennial (1960, 1970, 1980) population counts by age and sex for NYS,[12–14] while age- and sex-specific population estimates for intercensual years were furnished by the New York State Department of Health Bureau of Biometrics. Trends in incidence rates were evaluated by considering the slope of the regression line (t-test) using Statistical Analysis System (SAS) computer software.[15] Ninety-five percent confidence intervals for incidence rate ratios were calculated as described by Rothman.[16]

A second comparison involved the calculation of average annual age-specific osteosarcoma incidence rates, among males and females between 1970 and 1987. Histologic codes were assigned according to the Manual of Tumor Nomenclature and Coding[17] or more recently the International Classification of Diseases for Oncology.[18] Due to a different histologic classification scheme in use before 1970 it was not possible to distinguish histologic subtypes of bone cancers reported to the Registry prior to 1970. Trends in osteosarcoma incidence rates were also evaluated using the procedures described above.

Drinking water supplies in New York State contain no appreciable levels of naturally occurring fluoride. Thus, fluoridated water supplies are all artificially fluoridated. A third comparison evaluated average annual age-specific incidence rates for bone cancers and osteosarcomas, between 1976 and 1987, among males and females residing in fluoridated and nonfluoridated communities. Two metropolitan areas in New York State have maintained nonfluoridated drinking supplies: the City of Albany and Suffolk County.[19] Since less than 10 percent of the Nassau County population consumes fluoridated water, this metropolitan area was also considered to be nonfluoridated for the purposes of this study. Together, the 1980 population of these nonfluoridated areas (Albany, Suffolk County, Nassau County) was 2,707,540.[13] Since the nonfluoridated areas are urbanized communities, osteosarcoma incidence rates in these areas were compared with incidence in two groups of fluoridated communities: 1) counties located within standard metropolitan statistical areas (i.e. urbanized areas), and 2) counties not located within standard metropolitan statistical areas. Residents of nonmetropolitan areas are less likely to be served by a public water supply. Since these incidence rates were based on a limited number of cases (due to the infrequent occurrence of osteosarcomas), the standard error (SE) of each incidence rate was estimated by dividing the rate by the square root of the number of cases upon which it is based.[20]

Results

Between 1955 and 1987, 3,166 bone cancers were diagnosed among residents of New York State, exclusive of New York City (1,824 males, 1,292 females). About one-third (n = 1,100) of these cases occurred among persons less than 30 years of age at diagnosis (652 males, 448 females); 2,016 cases occurred among persons ages 30 and over at time of diagnosis (males 1,172, females 844).

Trends in Bone Cancer Incidence Rates

For bone cancers among persons less than 30 years of age at diagnosis, the slope of the regression line was significant among males ($p = 0.002$) with an observed increase in bone cancer incidence of 54 percent during the 1955–87 period. Among females (<30 years), bone cancer incidence increased 44 percent; however, the slope of the regression was not significant at the 5 percent level ($p = 0.07$). Further exploration of trends in bone cancer incidence among persons less than 30 years of age at time of diagnosis reveals that, relative to the period 1955–63, a significant increase in bone cancer incidence among males occurred only after 1969, while among females incidence was not significantly increased until the 1983–87 period (Table 1).

Bone cancer incidence rates among persons age 30 years and over at diagnosis show a significant decrease among both males (44 percent decrease, $p = 0.0001$) and females (33 percent decrease, $p = 0.0001$). Relative to incidence during the period 1955–1963, bone cancer incidence rates among males were significantly decreased during the period 1970–75 and thereafter (Table 1). Among females age 30 years and older at diagnosis, significant decreases in bone cancer incidence rates did not occur until after 1975.

Trends in Osteosarcoma Incidence Rates

Among persons less than 30 years of age at time of diagnosis, 196 and 113 osteosarcomas were diagnosed among males and females, respectively, between 1970 and 1987. While there was some variation in annual osteosarcoma incidence rates, between 1970 and 1987, among persons less than 30 years of age at diagnosis, the slope of the regression line was not significant among either males (16 percent increase, $p = 0.71$) or females (18 percent increase, $p = 0.45$). As shown in Table 2, osteosarcoma incidence rates did not differ significantly during three six-year periods between 1970 and 1987.

Between 1970 and 1987, 135 osteosarcomas were diagnosed among males and 103 osteosarcomas were diagnosed among females age 30 years or older at time of diagnosis. Based on the slope of the regression line, osteosarcoma incidence rates have been stable among both males (16 percent decrease, $p = 0.58$) and females (24 percent increase, $p = 0.29$) over 30 years of age at diagnosis. Osteosarcoma incidence rates did not differ significantly during three six-year periods between 1970 and 1987 (Table 2).

TABLE 1—Rate Ratios by Sex and Age at Diagnosis for Bone Cancer Incidence Rates per Million among Residents of New York State, Exclusive of New York City, 1955–87

	<30 Years at Diagnosis							
	Males				Females			
Year of Diagnosis	No.	Rate	RR*	(95% CI)**	No.	Rate	RR	(95% CI)
1955–1963	116	6.1	1.00		91	4.8	1.00	
1964–1969	111	7.3	1.20	(0.93, 1.56)	86	5.7	1.19	(0.88,1.60)
1970–1975	132	8.2	1.34	(1.04, 1.72)	88	5.5	1.15	(0.86,1.54)
1976–1981	156	10.0	1.64	(1.29, 2.10)	85	5.6	1.17	(0.87,1.57)
1982–1987	137	9.4	1.54	(1.22, 1.97)	98	6.9	1.44	(1.09,1.94)
t-test for trend:*** p = 0.002							p = 0.07	
	30+ Years at Diagnosis							
	Males				Females			
Year of Diagnosis	No.	Rate	RR	(95% CI)	No.	Rate	RR	(95% CI)
1955–1963	392	19.8	1.00		245	11.4	1.00	
1964–1969	253	18.2	0.92	(0.78, 1.08)	181	11.7	1.03	(0.84,1.24)
1970–1975	204	14.3	0.72	(0.61, 0.86)	154	9.4	0.82	(0.68,1.01)
1976–1981	150	10.1	0.51	(0.42, 0.61)	125	7.2	0.63	(0.51,0.79)
1982–1987	173	11.0	0.56	(0.46, 0.66)	139	7.6	0.67	(0.54,0.82)
t-test for trend: p = 0.0001							p = 0.0001	

*RR, rate ratio relative to 1955–1963 period.
**95% confidence interval.
***t-test for trend using annual incidence rates between 1955 and 1987.

TABLE 2—Rate Ratios by Sex for Osteosarcoma Incidence Rates per Million among Residents of New York State, Exclusive of New York City, 1970–87

	<30 Years at Diagnosis							
	Males				Females			
Year of Diagnosis	No.	Rate	RR*	(95% CI)**	No.	Rate	RR	(95% CI)
1970–1975	61	3.8	1.00		35	2.2	1.00	
1976–1981	71	4.6	1.21	(0.86,1.70)	41	2.7	1.23	(0.78,1.93)
1982–1987	64	4.4	1.16	(0.84,1.64)	37	2.6	1.18	(0.77,1.87)
t-test for trend:*** p = 0.71							p = 0.45	
	30+ Years at Diagnosis							
	Males				Females			
Year of Diagnosis	No.	Rate	RR	(95% CI)	No.	Rate	RR	(95% CI)
1970–1975	45	3.2	1.00		28	1.7	1.00	
1976–1981	48	3.2	1.00	(0.68,1.54)	36	2.1	1.24	(0.75,1.98)
1982–1987	42	2.7	0.84	(0.56,1.28)	39	2.1	1.24	(0.79,1.95)
t-test for trend: p = 0.58							p = 0.29	

*RR, rate ratio relative to 1970–1975 period.
**95% confidence interval.
***t-test for trend using annual incidence rates between 1970 and 1987.

Bone Cancer, Osteosarcoma Incidence and Fluoridated Drinking Water

As shown in Table 3, average annual sex- and age-specific bone cancer and osteosarcoma incidence rates (1976–87) did not differ between areas with and without fluoridated drinking water supplies.

Discussion

Although changes in bone cancer incidence since 1955 are evident, these changes have not been consistent between age groups or between the two genders. Bone cancer incidence rates among males less than 30 years at diagnosis have increased since 1955, while no statistically significant change in incidence was observed among females in this age group. Among persons ages 30 years and older, significant decreases in bone cancer incidence were noted among both males and females since 1955. Incidence increases, which have occurred, have been re-

TABLE 3—Age- and Sex-specific Incidence Rates per Million for Bone Cancers and Osteosarcomas among Residents of New York State, Exclusive of New York City, 1975–87, by Age at Diagnosis

	Bone Cancer Incidence								
	Nonfluoridated Areas			Fluoridated SMSA* Counties			Fluoridated NonSMSA Counties		
Age at Diagnosis	No.	Rate	(SE)**	No.	Rate	(SE)	No.	Rate	(SE)
<30 years									
males	75	9.7	(1.12)	158	9.0	(0.71)	60	11.3	(1.46)
females	51	6.7	(0.94)	110	6.4	(0.61)	22	4.3	(0.92)
30+ years									
males	98	12.4	(1.25)	181	10.4	(0.78)	44	9.0	(1.36)
females	64	7.0	(0.87)	162	8.0	(0.62)	38	6.7	(1.12)

	Osteosarcoma Incidence								
	Nonfluoridated Areas			Fluoridated SMSA* Counties			Fluoridated NonSMSA Counties		
Age at Diagnosis	No.	Rate	(SE)**	No.	Rate	(SE)	No.	Rate	(SE)
<30 years									
males	34	4.4	(0.75)	75	4.3	(0.43)	26	4.9	(0.96)
females	24	3.2	(0.64)	44	2.5	(0.38)	10	2.0	(0.62)
30+ years									
males	26	3.3	(0.64)	50	2.9	(0.41)	14	2.9	(0.77)
females	22	2.4	(0.51)	45	2.2	(0.33)	8	1.5	(0.51)

*SMSA = Standard Metropolitan Statistical Areas.
**SE = standard error.

stricted to more recent time periods among the cohort of persons born after the initiation of widespread artificial fluoridation of water supplies suggesting that any potential association with fluoride must be differential by age. The increased bone cancer risk observed in younger persons could be consistent with lifelong exposures to fluoride including exposures at times when growth rates for skeletal tissue are at a peak. However, other findings from this study do not support an association between exposure to fluoridated water and bone cancers. The incidence of bone cancers and osteosarcomas was not found to differ between areas with and without fluoridated drinking water supplies.

The potential specificity of effect from fluoride exposure was also examined by evaluating trends in the incidence of osteosarcomas. The incidence of osteosarcomas reveal no significant changes among either males or females, in either age group, since 1970. An examination of osteosarcoma incidence, between 1976 and 1987, in areas which have remained nonfluoridated did not indicate any significant differences compared to areas supplied by fluoridated water sources.

The limited secular increases observed in the number of bone cancer cases and osteosarcoma cases suggest that any potential effect of fluoride is probably minimal. Among population subgroups demonstrating incidence increases, the estimated annual increase in rates of bone cancers and osteosarcomas was 1–2 percent. Despite the ubiquitous nature of fluoride exposures, bone cancer and osteosarcomas remain as relatively infrequent cancers.

As with most previous studies of potential health effects resulting from exposure to fluoridated drinking water, the present study utilizes an ecological design and lacks precise measures of exposures to fluoridated drinking water, and other fluoride sources, at an individual level. Further, this study has not attempted to account for population mobility and movement between fluoridated and nonfluoridated areas. While most fluoridation of water supplies occurred during the 1950s and 1960s, some communities across New York State have initiated fluoridation of drinking water supplies at later times.

Although these data do not demonstrate consistent shifts in the incidence of bone cancers or osteosarcomas, recent increases in bone cancer incidence relative to the 1955–63 period are evident, particularly among younger persons. At this time it is not possible to establish an association between fluoride and bone cancer incidence. The potential role of fluoride in the incidence of bone cancers might be more thoroughly investigated using an analytic study design allowing more careful assessment of residential history to minimize misclassification of exposure to fluoridated drinking water and an examination of fluoride exposure from sources other than drinking water. ☐

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Federal Hazardous Waste Law Plagued by Ambiguities, says Report

A portion of the 1986 federal law requiring each of the 50 states to ensure the availability of hazardous waste treatment or disposal facilities over the next 20 years has been plagued by ambiguities, unanswered policy questions, and at least one lawsuit, according to a report to the US Environmental Protection Agency (EPA) by a Tufts University researcher. The report by Sharon N. Green, senior environmental research analyst at Tufts' Center for Environmental Management (CEM), recommends that Congress reassess the need for hazardous waste treatment and disposal facilities, given uncertainties about waste generation and management over the next 20 years.

The report cites data from 13 Northeast states projecting an 18 percent decline in hazardous waste generation by the year 2009, based on economic forecasting, waste reduction programs, expected new regulations, and contaminated site cleanups.

In her report, Green suggests a 15-point set of recommendations, including that the goals of the current provision be clarified to explicitly address waste reduction, facility siting, and attaining geographic equity for waste management services.

Other recommendations in the report, released in December 1990, include:

- Congress should consider state and federal roles in providing hazardous waste management services, given that responsibility for waste generation and management currently rests with the private sector.
- Congress should reconsider the appropriateness of threatening non-complying states with the loss of federal funds for hazardous waste cleanup projects.
- EPA should provide additional guidance to states in preparing hazardous waste projections.
- Data collection and planning methods among the states should be standardized.

"Capacity assurance planning probably will become a viable public policy only if significant revisions are made to the structure and function of the provision and implementation process," Green concludes in the report.

Public Health Briefs

Neonatal Diarrhea at a Maternity Hospital in Rangoon

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ABSTRACT

Between 1981 and 1986, 1,540 infants born at the Central Women's Hospital in Rangoon were transferred to the Sick Baby Unit because of diarrhea (15.4 per 1,000 live births). Rates among cesarean infants were five times as high as those of infants born vaginally (51.0 and 10.3 per 1000 live births, respectively). One hundred eighty-four of the infants with diarrhea died (case fatality rate = 12 percent). We conclude that neonatal diarrhea is endemic in this large maternity hospital in Burma, and that control efforts should be targeted especially to cesarean and low birthweight infants. (*Am J Public Health* 1991; 81:480–481)

Introduction

Neonatal diarrhea was an important problem in American and Western European hospitals in the 1940s and 50s[1-6]; in recent years it has become relatively rare. The reported episodes of diarrhea tended to occur in clusters and were often associated with particular serotypes of *E. coli* which became known as enteropathogenic *E. coli* (EPEC).[7-10]

In developing countries diarrhea is a major endemic public health problem with an estimated five million deaths annually.[11] The bulk of the cases occur between the ages of six months and five years and most strategies for diarrheal disease control are targeted to this age group. Relative to this massive public health problem, neonatal diarrhea occurring in children born in hospital appears to be a relatively minor one.

Nevertheless, increasing numbers of children are born in developing country hospitals. A previous three-month survey in two Rangoon maternity hospitals found neonatal diarrhea to be the leading cause of transfer to the Sick Baby Unit (SBU) and the largest single cause of death among infants dying in the SBU (unpublished, Nyunt Nyunt Wai). Nevertheless a literature search based only on MEDLINE failed to find articles dealing with nosocomial neonatal diarrhea in developing countries. We therefore initiated this retrospective study to describe certain features of the problem.

Methods

The study was carried out at Central Women's Hospital, the largest of the hospitals serving maternity patients in Rangoon, Burma with about 16,000 deliveries annually. Formerly, newborn infants were cared for in nurseries separated from the mothers, and mothers and infants remained in hospital routinely for four to five days. During the period of the study, policies were introduced to promote "early discharge" (routine discharge one or two days after delivery) and "rooming in." Infants were said have "rooming in" if they were cared for by their mothers and stayed in cribs at the mother's bedside in large wards rather than residing in ward nurseries separated from their mothers except for feeding time. For infants born by cesarean section, these changes in policy did not apply and infants were for the most part cared for in nurseries by nurses.

This analysis is based on a review of the log from the SBU. Data include all admissions to the unit between 1981 and 1986 with diarrhea as the admitting diagnosis. The total numbers and types of delivery, obtained from annual hospital records, were used as denominators in calculating rates. Using the monthly totals which were available for the years 1983 through 1986, an estimate was made of the monthly distribution of deliveries for the period 1981–86.

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Editor's Note: See also related editorial p. 415 this issue.

TABLE 1—Numbers and Rates of Neonatal Diarrhea (transfers to Sick Baby Unit) Occurring in Infants Born by Vaginal Delivery or Cesarean Section by Year

Year	Vaginal (rate)	Cesarean (rate)	Overall rate
1981	236 (16.9)	133 (65.5)	22.4
1982	202 (14.4)	106 (50.1)	18.6
1983	130 (8.8)	63 (31.4)	11.2
1984	127 (8.9)	125 (54.6)	14.9
1985	92 (6.4)	123 (53.6)	12.8
1986	94 (6.6)	109 (49.5)	12.7
Totals	881 (10.3)	659 (51.0)	15.4

*Rate in cases per thousand live births

Episodes of mild diarrhea in which the infant was not transferred to the SBU would not have been detected in this surveillance, nor would episodes occurring after discharge if the child did not return to the same hospital. This review therefore underestimates the numbers of cases actually occurring, but there was no apparent bias over time since the record-keeping and referral system remained constant.

Data analysis was performed using Crunch Interactive Statistical Package Version 3.0 with a PC DOS microcomputer. Statistical tests used were chi square, Fisher's exact or Mann Whitney tests where appropriate.

Results

During the six years under study, 1,540 infants were admitted to the SBU because of diarrhea. The annual number of cases ranged from 193 to 368 (rates of 11.2 to 22.4 per 1,000 live births). Overall rates for the first two years were higher than for subsequent years (Table 1). The monthly rates were higher during the post monsoon dry season (rates averaged 17.5 per 1,000 live births, October–January) and lower during the hot monsoon season (rates averaged 13.5 per 1,000 live births for May–August).

The overall yearly rates decreased during the period of study associated with a decrease in vaginal delivery rates. By contrast the rates associated with cesarean section were higher and remained unchanged (Table 1). Overall, infants born by section had a five times higher risk of developing diarrhea than those born by vaginal delivery (95% CI = 4.5, 5.5).

One hundred eighty-four (12 percent) of the infants with neonatal diarrhea died. Fatal cases tended to be older when admitted to the SBU (median of seven days for fatal cases vs six days for nonfatal, $p < .001$), to be smaller at birth (relative risk for birthweight < 2.3 kg = 4.6 (C.I. = 3.5, 6.0)). Infants with larger birthweights (> 3.6 kg) were also at higher risk (relative risk = 2.7 (C.I. = 1.2, 5.8, Fisher's exact = 0.036) when compared to those with birthweights between 2.3 and 3.6 kg. Although infants born by section were at a higher risk of diarrhea, they were not at a higher risk of dying with diarrhea. Case fatality rates were not different according to sex or ethnic group, but infants born of mothers with more than seven previous pregnancies were at higher risk ($p = 0.02$).

The available records did not permit a comparison of the case fatality rates of different clinical syndromes or of the possible benefits of specific forms of treatment on the case fatality rates.

Discussion

This study has demonstrated that diarrhea sufficiently severe to lead to transfer to the SBU was common in this Rangoon hospital between 1981 and 1986. The case fatality rate of 12 percent reinforces the severity of the problem. Cesarean section was the most prominent risk factor for diarrhea identified in the study (RR = 5.0). These infants tend to stay in the hospital longer, to be handled more by hospital staff and less by mothers, and to be fed more formula and less breast milk than other infants.

For children born by vaginal delivery, the rates of neonatal diarrhea decreased three-fold during the period of study. This decrease may have been related to "rooming in" and "early discharge" policies; however, we were not able to determine if these policies were effective, since the changes were phased in over a prolonged period and did not allow for a "before–after" analysis.

There are obvious limitations in the study which need to be addressed. As a retrospective study the cases detected likely underestimate the problem. Case definitions depended on the diagnosis of "diarrhea" at the time of transfer, rather than an actual description and quantitation of symptoms. Cases were not evaluated bacteriologically to determine the causative agents. Finally, there may be other relevant risk factors (types of formula, hand washing, etc.) which were not evaluated.

Nevertheless, the study clearly documents the importance and endemicity of the problem and suggests the need for further research as well as control strategies based on observations of current practice. ☐

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Effect of Hospital Utilization Review on Medical Expenditures in Selected Diagnostic Areas: An Exploratory Study

Thomas M. Wickizer, PhD

ABSTRACT

Quarterly claims data on 43 insured groups were analyzed through multivariate techniques to explore whether the effects of hospital inpatient utilization review vary across selected broad diagnostic areas. Findings suggest that utilization review was associated with decreases in expenditures of approximately 15 percent for diagnoses within the surgical area, a lesser decrease within the mental health area, and still lesser decrease within the medical area. However, these measurements are imprecise both because of the small numbers and the aggregated diagnoses in each category. (*Am J Public Health* 1991;81:482–484)

Introduction

Hospital inpatient utilization review (UR) has assumed a prominent role as a private cost containment activity[1,2]; 65 percent of group insurance plans now operate under some form of UR.[3] UR evaluative research has produced mixed results,[4] with some studies finding large reductions in hospital use associated with UR[5–10] and other studies finding little if any effect.[11–15] Unfortunately, many of the UR evaluations suffer from methodological problems that raise questions about the reliability of the findings.[4,16]

One recently initiated study, conducted by the present author and colleagues, used multivariate techniques to analyze claims data on 223 insured groups. The study found UR was associated with significant reductions in hospital admissions, inpatient expenditures, and total medical expenditures.[17,18] However, the question of whether UR may have different effects across diagnostic categories was not examined, nor has this question been examined by other studies. The purpose of this paper is to report the findings of such an analysis.

Methods

The UR program analyzed, described in more detail elsewhere,[19] was established in 1983 by CNA Insurance Companies of Chicago and made available to policyholders as a benefit plan option. It consists of preadmission authorization and concurrent review and is compulsory for all employees and dependents. Patients failing to comply with UR procedures are subject to financial penalties. Physicians and hospitals are not subject to penalties.

The unit of observation for the analysis is the insured group. Expenditure data covering the period 1984 through 1986 were collected for selected diagnostic categories on 43 groups that adopted UR after operating without any cost containment program. Well-distributed geographically and representative of the under-65 population in terms of hospital use, these groups were selected for study because they provide longitudinal data (pre- and post-UR data) that permit the use of an efficient method of analysis. (Because of resource limitations, it was not possible to collect claims data by diagnosis for all 223 groups included in the larger study.) The average group includes approximately 1,300 insureds, comprising 550 employees and 750 dependents.

Quarterly claims data on the 43 groups were pooled, making 443 usable and complete observations available for analysis. To examine the effects of UR across diagnostic areas, measures were created representing mental health services, medical services, and surgical services. These measures were constructed by summing expenditures over selected diagnostic categories for which the insurance carrier routinely collected claims data. The term diagnostic area is somewhat imprecise. In general, it represents a set of conditions for several related ICD-9-CM diagnostic categories, but it bears no direct relationship to diagnosis related groups (DRGs) or other diagnostic classifications.

For the *mental health area*, expenditures were summed over alcohol, drug abuse, psychoses, and neuroses. For the *medical area*, expenditures were summed over diabetes, hypertension, infectious and allergy diseases, obstructive pulmonary disease, viral infections, and cutaneous diseases of the skin. For *surgical services*, expenditures were summed over benign neoplasms, diseases of the esophagus and stomach, diseases of the bones and cartilage, and musculoskeletal injuries.

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Descriptive information on the expenditure measures is presented in Table 1. The measures, which capture all inpatient as well as outpatient covered charges, represent services accounting for approximately 40 percent of total nonobstetric expenditures. Surgical services have the largest proportion of cases (28 percent) with quarterly expenditures over $30 per insured person. Included in the analysis is a set of 16 covariate factors, described in detail elsewhere,[19] representing employee population characteristics, health care market factors, and benefit plan features (see Appendix).

UR is measured by a binary variable that takes on a value of 1 if a group operated under UR during a given quarter, and 0 otherwise. It was not possible to distinguish preadmission authorization from concurrent review for purposes of analysis.

Ordinary least squares (OLS) regression was used to estimate a covariance model, constructed by differencing each observation from its time mean.[19-21] This model, which uses within-group (over time) variance to identify parameters, produces the same estimates as the standard fixed-effects (or least squares dummy variable) model but does not require inclusion of group-specific dummy terms, thereby saving degrees of freedom and improving computational efficiency. Since aggregate data collected over time were being analyzed on groups differing in size, procedures were performed to test for heteroscedasticity[22] and serial correlation.[23] The model's error terms were found to be heteroscedastic, and a standard weighting procedure was performed on the data to correct the standard errors. Specification tests revealed no evidence of serial correlation.

Three equations were estimated, one for each of the three services, with the covariate factors and the UR term included on the right hand side of the equations, in addition to a set of quarter dummy variables included to control for unmeasured temporal factors.

Results

The results of the analysis are presented in Table 2. As indicated, UR was associated with somewhat lower expenditures ($p < .07$) in the surgical area; after adopting UR the average group's expenditures for this diagnostic area declined by approximately 15 percent. This estimated percentage reduction implies an absolute reduction in surgical expenditures of ap-

TABLE 1—Descriptive Information on Dependent Measures (N = 433)

Measures	<$10.00 per Insured Person per Quarter[a]	$10.00 to $19.99 per Insured Person per Quarter	$20.00 to $29.99 per Insured Person per Quarter	>$30.00 per Insured Person per Quarter
Expenditures on Medical Services[b] (%)	109 (25)	184 (43)	88 (20)	52 (12)
Expenditures on Surgical Services (%)	57 (13)	148 (34)	106 (25)	122 (28)
Expenditures on Mental Health Services (%)	226 (52)	76 (18)	60 (14)	71 (16)

a) Expenditure data were adjusted by the Medical Care Price Index (MCPI) to reflect January 1985 prices.

b) The means and standard deviations (SD) for the three measures are: 1) Medical Expenditures, mean $17.78, SD $12.06; 2) Surgical Expenditures, mean $25.55, SD $21.32; and 3) Mental Health Expenditures, mean $16.16, SD $20.83.

TABLE 2—The Effects of UR on Expenditures for Three Diagnostic Areas: Mental Health, Medical, and Surgical Services (N = 433)

Measures[a]	Medical Expenditures	Surgical Expenditures	Mental Health Expenditures
Intercept	0.142* (0.087)[b]	0.131 (0.095)	0.261 (0.244)
% Female Employees under Age 30[c]	0.100 (0.173)	0.134 (0.193)	−0.204 (0.489)
% Male Employees Ages 30 to 50	0.023 (0.046)	0.058 (0.051)	0.157 (0.131)
% Female Employees Ages 30 to 50	0.005 (0.137)	−0.105 (0.152)	0.428 (0.386)
% Male Employees over Age 50	0.012 (0.029)	0.024 (0.032)	−0.015 (0.081)
% Female Employees over Age 50	−0.155 (0.300)	0.033 (0.332)	−0.597 (0.845)
% Childbirth/Pregnancy Expenditures	−0.901* (0.563)	−0.277 (0.623)	−0.086 (1.585)
% Heart Disease Expenditures	−0.298 (0.635)	−0.164 (0.703)	0.648 (1.789)
HMO Penetration Rate	0.015 (0.026)	0.037 (0.028)	−0.015 (0.072)
Office-Based Physicians per 1,000 Population	1.265 (0.917)	−0.822 (1.014)	−1.466 (2.584)
% General Practice Physicians	−2.246 (1.956)	−1.397 (2.164)	−0.841 (5.511)
Hospital Occupancy	−0.028** (0.013)	−0.029* (0.015)	−0.038 (0.037)
% Charges Covered for Semi-Private Room	0.001 (0.002)	−0.001 (0.003)	0.010 (0.007)
% Charges Covered for Hospital Outpatient Services	0.004 (0.003)	−0.000 (0.004)	−0.021** (0.010)
% Charges Covered for Physician Office Services	0.002 (0.005)	−0.001 (0.006)	−0.014 (0.016)
Deductible	−0.014 (0.017)	0.034* (0.019)	0.084* (0.049)
Utilization Review[d]	−0.062 (0.097)	−0.157* (0.108)	−0.146 (0.274)

NOTE: R^2 is not shown because this does not provide a meaningful indication of the model's explanatory power for mean-differentiated equations.

a) The coefficients of the quarter dummy variables are not included in Table 2 for economy of presentation.

b) Standard errors are shown in parentheses.

c) The reference variable is % Male Employees under age 30.

d) Since the dependent variable is measured in logarithms, the coefficients of the utilization review (dummy) variables can be interpreted as approximate percentage differences. The actual percentage difference in expenditures pre- versus post-UR is slightly lower than indicated by the coefficients. For example, the coefficient −0.157 for the surgical expenditure equation implies a 14.7 percent reduction in expenditures.

*$p < .10$; **$p < .05$

proximately $17.25 per insured person per year. Although the estimated UR coefficient for the mental health area is almost as large, it is not statistically significant due to the large standard error estimate. It appears UR has a less important effect on medical expenditures. As Table 2 shows, with few exceptions the covariate factors are not statistically significant.

Discussion

This exploratory analysis has sought to contribute to an improved understanding of an important question regarding the effects of hospital UR. The findings suggest UR's effects vary across diagnostic areas, and that UR may be more effective in reducing expenditures on diagnoses likely to involve surgical services than other services, especially medical services. One plausible explanation for this finding is that UR protocols may be better developed for surgical cases than for other cases. To work effectively, UR must have clinical protocols that can be followed and used to establish the need for hospital care. Such protocols may be better developed for surgery than other areas, which may explain, in part, why UR appears to be more effective for cases likely to involve surgical services. However, given the limitations of the data, these findings should be considered preliminary. Future research should conduct analyses using more complete and detailed data to examine this question in greater depth. □

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APPENDIX—Descriptive Information on Covariates Included in the Analysis (N = 433)

Measures	Mean (Standard Deviation) %
% Female Employees under Age 30	10.1 (8.0)
% Male Employees under Age 30	11.9 (6.8)
% Male Employees Ages 30 to 50	35.2 (9.2)
% Female Employees Ages 30 to 50	18.6 (9.8)
% Male Employees over Age 50	17.3 (10.0)
% Female Employees over Age 50	6.5 (3.7)
% Childbirth/Pregnancy Expenditures[a]	8.1 (7.4)
% Heart Disease Expenditures[a]	4.1 (5.6)
HMO Penetration Rate	11.5 (13.7)
Office-based Physicians	2.3 (1.2)
% General Practice Physicians	13.4 (11.2)
Hospital Occupancy	67.2 (8.7)
Deductible	$130 ($52)
% Charges Covered for Semi-Private Room	86.5 (24.3)
% Charges Covered for Physician Office Services	83.7 (16.4)
% Charges Covered for Hospital Outpatient Services	88.2 (20.4)
Utilization Review	0.75 (0.44)

a) Measured as a percentage of total expenditures.

Tracking Progress toward National Health Objectives in the Elderly: What Do Restricted Activity Days Signify?

ABSTRACT

Restricted activity days is the measure by which the 1990 health objectives for prevention of functional disability in older adults will be evaluated. Yet its significance in older populations is poorly understood. We evaluated its use as an outcome measure for a randomized trial designed to impact upon physical function in elderly HMO enrollees. As predicted, restricted activity days was more correlated with physical disability measures than with other health status measures. Distributional properties and rates of missing data were shortcomings. (*Am J Public Health* 1991;81:485–488)

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Introduction

In 1979, the US Surgeon General's report[1] designated the prevention of functional disability as the principal goal of health promotion in older adults. Restricted activity days (RAD), a standard item on the National Health Interview Survey, was chosen as the primary measure of disability to be monitored with the goal of achieving a 20 percent reduction by 1990. Evaluation of progress toward this goal is hampered because the meaning of RAD as a measure of health status in the elderly remains uncertain.[2,3] In younger age groups, RAD reflect transient loss of ability to perform social roles at work, home, or school, usually because of a physical limitation. In the elderly, many of whom are retired, usual activities are more variable. For this reason, several investigators have called for a better understanding of the appropriateness and usefulness in the elderly of such traditional health status measures as RAD.[4–6]

Because of the Surgeon General's 1990 objectives, we chose RAD as a primary outcome measure for an ongoing randomized controlled trial of health promotion involving nearly 2,300 older adults. We hypothesized that RAD would be more strongly correlated with measures of physical disability than with measures of mental, social, and global self-perceived health. Since there has been some speculation that days spent in bed might be a better measure of health status than RAD,[7] we compared the associations of both variables with these other health status measures.

Methods

The study setting is Group Health Cooperative (GHC) of Puget Sound, an HMO (health maintenance organization) located in western Washington State. At the study's inception in 1987, approximately 11 percent of enrollees were age 65 or older. This report is based on data from 2,289 enrollees, 36 percent of a random sample of 6,328 seniors, who returned completed baseline questionnaires and agreed to participate in the trial.

The questionnaire covered a broad range of health beliefs, behaviors, and conditions and included a number of standard single-item measures and multi-item scales. Information was obtained on the number of RAD and days spent in bed for the preceding 12 months using the questions described in Table 1, Section A.

For comparison with RAD and bed days we selected a number of baseline measures of physical health (Table 1, Section B), several measures of mental and social health (Table 1, Section C), and two self-evaluations of health status (Table 1, Section D). Spearman rank correlation coefficients were used to assess the association between the disability day variables and the other health status measures. Measures within each health status domain (physical, psychosocial, and self-evaluated health) were correlated with each other and within-group correlations were compared with correlations of each measure with disability days.

To explore reasons for non-participation in the trial, we interviewed a random sample of 175 non-participants by telephone using an abbreviated version of the same questionnaire. Nonparticipants were similar to participants with respect to age, gender, the prevalence of chronic disease, and number of RAD. They had less education, lower incomes, higher rates of smoking, worse self-perceived health, and less participation in social activities.*

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*Wagner EH, Grothaus LC, Hecht JA, LaCroix AZ: Factors affecting participation in a senior health promotion trial. Manuscript under review.

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TABLE 1—Selected Health Status Indices from Senior Baseline Questionnaire

Health Status Measure	Description and/or Item Content	Source
A. Disability Days		
1. Restricted activity days	Two items: "In the past 12 months, did you cut down the things you usually do, such as going to work or working around the house, because of illness or injury?" IF YES: "How many days did you cut down on the things you usually do because of illness or injury?"	Adapted from NHIS[8]
2. Days spent in bed	Two items: "In the past 12 months, did you ever stay in bed because of an illness or injury?" IF YES: "How many days did you stay in bed at least half the day because of illness or injury?"	Adapted from NHIS[8]
B. Physical Health Measures		
1. Functional limitations	Guttman scale of seven daily living activities: "For how long (if at all) has your health limited you in each of the following activities? (1) The kinds or amounts of vigorous activities you can do . . . [least impaired] . . . (7) Eating, dressing, bathing or using the toilet [most impaired]". Coefficient of reproducibility = .91, coefficient of scalability = .61.	Adapted from Ware[9,10]
2. Illness	Single item: "In the past 12 months, have you had a major personal illness?"	
3. Hospitalization	Single item: "In the past 12 months, were you ever in the hospital overnight for physical health problems?"	
4. Pain	Single item: "We would like to find out about any physical pain you may experience in your daily life. Below is a scale from 0 (no pain) to 10 (very severe pain). Please place an 'X' on the line in the spot that most closely represents how much pain you experience on a daily basis."	Ware[11]
5. Symptoms	13 questions about a range of symptoms experienced in the past week: e.g. "I felt dizzy or lightheaded when I sat up or stood up"; "I had stomach cramps."	Developed for the study
6. Role limitations	Seven item scale on short-term physical limitations: "During the past 4 weeks, have you had any of the following problems with your work or other daily activities as a result of your physical health? a. Were limited in the kind of work or other activities you usually do?; g. Required special assistance (the assistance of others or special devices) to perform the activities you usually do."	Ware[10]
7. Heart Trouble	Single item: "Here is a list of medical conditions which usually last for some time. Have you had any of these conditions in the past 12 months?" Affirmative to "Heart trouble".	Belloc[12]
C. Social/Psychological Measures		
1. Life Satisfaction	11-item scale: "Below each question is a scale from 0–10, where 0 is "very satisfied" and 10 is "very dissatisfied". Please place an 'X' on the line by the number that most closely represents your response to each question."	Patrick[13]
2. Positive Affect/Pep and Vitality	Combined score from 10-item Positive Affect subscale and a number of items from a second subscale (Pep and Vitality): "During the past month . . . (a) how much of the time have you felt that the future looks hopeful and promising? . . . (m) how much energy, pep or vitality did you have or feel?" (6 response categories)	Adapted from Veit[14]
3. CES-D	10-item adaptation of the Center for Epidemiological Studies Depression Scale. "Please indicate by circling the appropriate response how often you have felt this way during the past week: (a) I was bothered by things that usually don't bother me . . . (j) I could not 'get going'."	Adapted from Radloff[15]
4. Stress	Single item: "Pictured below is a scale from 1 (none) to 10 (a great deal). Which number on the scale best represents how much stress you have been under for the past year?	Bailey[16]
5. Social Support	Single item: "Do you belong to a close circle of friends, a group of people who keep in touch with each other?"	Morgan[17]
6. Nervous Condition	Single item: "Here is a list of medical conditions which usually last for some time. Have you had any of these conditions in the past 12 months?" Affirmative to "Chronic nervous or emotional problems".	
D. Self-Evaluations of Health		
1. Self Perceived Health	Single item: "Would you say, in general, your health is (1) excellent . . . (5) poor?"	Ware[10]
2. Current Health Outlook	9-item subscale of General Health Perceptions Index: e.g. "My health is excellent"; "I have been feeling bad lately." (5 response categories)	Ware[10]

Results

Missing Values

In the 2,289 participants with completed baseline questionnaires, 11 percent of responses on RAD and 4 percent on bed days were missing. Missing data were more frequent for both measures among older respondents and those with poorer self-evaluated health (Figure 1.a., 1.b.).

Baseline Distribution of RAD and Bed Days

Both disability day variables had highly skewed distributions, as has been found for many measures of physical health in community-dwelling older populations.[14] Seventy-four percent of respondents reported no RAD and 73 percent reported no days spent in bed in the past 12 months.

Other Health Status Measures

Spearman correlations of RAD and bed disability days with selected measures of physical, psychosocial, and self-evaluated health status are presented in Table 2. Restricted activity days and bed days were highly correlated (.61); when the subset of RAD due to bed days was excluded, the correlation was .53. As hypothesized, the number of RAD was most strongly correlated with indicators of physical health (correlations ranged from .20 to .48), including the other two disability measures, functional and role limitations (r's = .34 and .39, respectively). Within-group correlations among physical health status measures ranged from .11 to .60.

Moderate correlations between RAD and the two self-evaluations of health were also found: .24 for self-reported health and .30 for current health outlook. However, these two measures were more highly correlated with each other (.68). The weakest associations with RAD were for the social support and mental health measures. Restricted activity days was more strongly correlated than bed days with all the physical health measures, except for hospitalization in the past 12 months (Table 2).

Our assessment of correlations between RAD and a subset of these variables in the sample of nonparticipants showed findings similar to the larger sample; RAD continued to be more strongly correlated with the available physical health status measures and had stronger correlations than bed days with most health status measures.

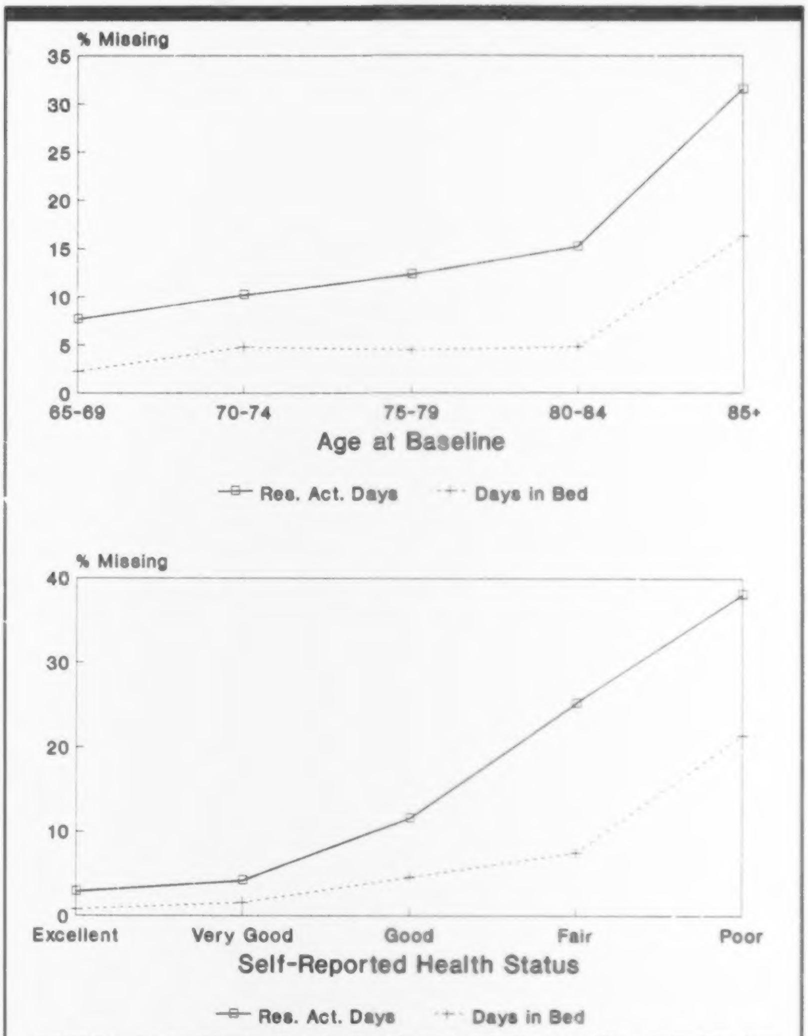

FIGURE 1—Rate of Missing Data for Restricted Activity Days and Days in Bed by Age Group and Self-reported Health Status

Discussion

The vague nature of RAD has been cited as a drawback to its use.[7] Our findings indicate that the potential shortcomings do not preclude its use in studies where physical disability is the health dimension of interest. The validity of using RAD is supported by its being most highly correlated with measures of physical health status and with functional limitation measures in particular.

Our results do not support the suggestion that bed days may be a better indicator of physical disability; its correlations with virtually all other health status measures were weaker than those for RAD.

While these results support our initial hypothesis, several limitations to the use of RAD deserve mention. Both disability days variables had very skewed distributions in this sample of essentially well elderly, limiting their usefulness in describing the full range of physical health status. In addition, over 10 percent of the data on RAD were selectively missing, an indication that this variable, in self-administered form, posed problems for participants.

The proportion of the sample that agreed to participate in this study represents a potential limitation of this analysis. This would be particularly so if non-participants were more disabled than those who agreed to be part of the study. Our study of nonparticipants allowed us to replicate this analysis in part and provided information that they had similar levels of disability and similar correlation patterns.

As evaluation of the 1990 national

TABLE 2—Correlation Matrix[1,2] for Disability Days, Physical and Social/Psychological Health Indices, and Self-Evaluations of Health

	A.		B.							C.						D.	
	1	2	1	2	3	4	5	6	7	1	2	3	4	5	6	1	2
A. Disability Days																	
1. Restricted Activity Days	/																
2. Days spent in bed	.61	/															
B. Physical Health Status Measures																	
1. Functional Limitations Scale	.34	.22	/														
2. Illness in past 12 months	.48	.46	.30	/													
3. Hospitalization in past 12 months	.41	.51	.22	.60	/												
4. Pain scale	.24	.15	.47	.17	.11	/											
5. Symptoms	.22	.13	.35	.17	.11	.34	/										
6. Role limitations	.39	.23	.56	.28	.19	.42	.42	/									
7. Heart disease	.20	.15	.25	.32	.28	.14	.21	.19	/								
C. Social/Psychological Measures																	
1. Perceived quality of life	.17	.10								/							
2. Positive affect	.20	.13								.60	/						
3. CES-D Depression Scale	.17	.12								.46	.59	/					
4. Stress	.18	.13								.46	.51	.39	/				
5. Circle of friends	.02	.05								.18	.19	.09	.06	/			
6. Nervous/emotional problems	.13	.05								.19	.25	.30	.30	.05	/		
D. Measures of General Well-Being																	
1. Self-reported health	.24	.16														/	
2. Current health outlook	.30	.21														.68	/

[1] For ease of presentation, all measures of health status are scored so that high scores indicate poorer condition (e.g. poorer life satisfaction, poorer affect, more depressive symptoms, etc.).

[2] Upper and lower limits for 95% confidence intervals for correlations can be obtained by adding and subtracting the following quantities to the correlations in the table: +/−.044 for correlations between 0 and .30; +/−.039 for correlations of .31 to .45; and +/−.033 for correlations of .46 to .61 For correlations involving the CES-D, corresponding figures are: .053, .047, and .039, due to higher rates of missing data.

health objectives continues, these findings may help to better characterize the role of RAD in older adults and provide added perspective on their place in the more broadly defined health objectives for the elderly for the year 2000. □

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Risk Communication Activities ~~of~~ State Health Agencies

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ABSTRACT

Surveys concerning the risk communication practices and needs of state health agencies were completed by agency commissioners and designated staff of 48 states and territories. These data indicate that agencies are expending more effort on responding to requests for information than on initiating dialogues with interested constituencies or alerting the public to risk. The data also suggest a gap between the stated philosophy and practice of the agencies. (*Am J Public Health* 1991; 81:489–491)

Introduction

Increasingly, government agencies have been concerned about how to communicate environmental health risks to the public. There is a growing literature prescribing how agencies should practice risk communication,[1–4] describing case studies of agency efforts,[5–9] and investigating public perception of risk.[10–13]

Nevertheless, little is known about the risk communication activities and needs of public health agencies. We report briefly the results of a national survey of state health agencies. Two detailed reports, one dealing with the data's implications for risk communication training and the other dealing more fully with analyses of state health agencies' risk communication activities, are available from the authors.

Methods

Early in 1989, the Association of State and Territorial Health Officials (ASTHO) distributed a risk communication survey (developed by the Rutgers Environmental Communication Research Program) to the health commissioners of the 50 states, five territories, and the District of Columbia. The survey was developed primarily to assess health agencies' risk communication needs. Therefore, the questions focused solely on risk communication rather than on the broader context of respondents' responsibilities, priorities, and resources. Health commissioners were asked to complete one survey themselves and to designate one person with technical background and one with communication background to complete individual copies of a similar survey. The surveys elicited returns from 128 respondents from 48 states and territories, with the 85 staff respondents accounting for 66.4 percent of all data analyzed and 43 commissioners accounting for 33.6 percent of analyzed data. Returned surveys reflect a 76.8 percent response rate for commissioners and a 75.9 percent response rate for agency staff.

Results

According to staff respondents, the five environmental health issues on which agencies devoted the most time to communicating with the public in the past year were: drinking water contamination (90.6 percent); radon in indoor air (64.7 percent); potential cancer clusters (62.4 percent); clean up of hazardous waste sites (57.6 percent); and pesticides (43.5 percent).

The dominant risk communication activity of agency staff is responding to inquiries (mean percentage of time = 62.1 percent). The remaining time is split between designing and planning outreach activities to alert the public to environmental health risks (21.8% percent) and soliciting input from the public on agency policies and actions (12.7 percent).

Staff reported that their agencies communicate on a daily basis with individuals who contact them with questions about environmental issues, but they initiate contact only about once a week. They talk only once or twice a month with environmental advocacy groups, other groups that address specific environmental issues, and neighborhood community groups.

When responding to inquiries, staff reported that the people with whom they speak most frequently have learned about a potential risk from the media and that they deal most frequently with people who have emotional responses to risk (Table 1).

When soliciting input from people outside the agency on agency policies and environmental health issues, staff reported that their agencies used telephone contacts and informal meetings more frequently than seven other sources of input

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TABLE 1—Average Responses From Staff of Inquiry Sources, Inquiry Type, Sources of Outside Input, and Outreach Methods

	Mean[a]	Standard Deviation[a]	Median[a]
Inquiry Source			
Individuals who learned about risk from the media	3.55	1.06	4.00
Individuals from environmental or health advocacy groups	2.41	1.02	2.00
Individuals who learned about risk from agency outreach methods	2.25	1.05	2.00
Individuals who raise concerns not yet known to agency	2.11	1.13	2.00
Inquiry Type			
Inquiring people have emotional responses to risk	3.62	1.23	4.00
Inquiring people are concerned about other issues besides risk	3.46	1.16	3.00
Inquiring people want explanations of risk data	2.87	1.33	3.00
Inquiring people want information about agency's risk management process	1.77	1.03	1.00
Source of Outside Input			
Telephone contacts	2.66	1.32	3.00
Informal meetings	2.45	0.95	2.00
Public hearings/other formal public meetings	2.05	1.00	2.00
Formal task forces	1.94	1.05	2.00
Hotlines	1.93	1.40	1.00
Public announcements requesting responses to written proposals	1.77	1.00	1.00
Questionnaires	1.33	0.57	1.00
Polls	1.07	0.34	1.00
Outreach Methods			
Telephone calls to individuals	2.65	1.42	3.00
Via local officials	2.44	1.10	2.00
Contact by technicians during sampling	2.33	1.40	2.00
Agency attendance at meetings	2.28	0.88	2.00
Health advisories	2.17	1.07	2.00
Initiating media stories	2.10	1.12	2.00
Hearings/other formal public meetings	1.95	0.85	2.00
Flyers/handouts	1.90	1.07	2.00
Public service announcements/advertisements in the media	1.89	1.07	2.00
Via community or environmental groups	1.87	1.02	2.00
Agency-sponsored informal meetings	1.81	0.76	2.00
Drop-in sessions in the affected area	1.75	1.07	1.00
Posting of announcements	1.72	0.95	1.00
Mass mailings	1.52	0.85	1.00

[a] Descriptive statistics were calculated from a five-point Likert-type scale where (1) indicated an answer of "seldom or never," (2) indicated an answer of "monthly," (3) an answer of "weekly," (4) an answer of "daily," and (5) indicated an answer of "constantly."

(Table 1). However, no single approach was used very often—perhaps a few times a month, at most.

Much the same can be said for the frequency with which agencies conduct activities to alert the public to potential environmental hazards. Across 14 different methods, the most any one method was practiced was a few times a month. Most methods were used monthly and a few were used less than once a month (Table 1).

We probed agency philosophy with 10 statements. More than two-thirds of all respondents either "agreed" or "strongly agreed" with the following five statements:

- "communicating with the public about environmental risk is an important agency priority" (90.6 percent);
- "risk communication training is important to improve agency efforts" (87.3 percent);
- "a major barrier to effective environmental risk communication is public misunderstanding" (82.4 percent);
- "a major barrier to environmental risk communication is insufficient training for new and existing staff" (75.8 percent); and
- "a major barrier to effective environmental risk communication is insufficient staff for risk communication" (67.2 percent).

More than two-thirds of all respondents either "disagreed" or "strongly disagreed with these two statements:

- "communicating with the public about environmental issues does not make much of an impact" (88.2 percent); and
- "better to communicate less than to risk stirring up problems" (76.4%).

More than half "disagreed" or strongly disagreed with

- "the public should be encouraged to leave risk management decisions to the professionals" (57.1 percent).

Discussion

These data suggest that agencies, in spite of their philosophical commitment, are expending more effort on responding to requests for information than on initiating dialogues with interested constituencies or alerting the general public to risk.

Most agency efforts are devoted to responding to inquiries from the public, and most inquiries from the public are generated by the media. Although respondents indicated that their agencies spent more than 20 percent of their communication time on outreach activities, they reported using most outreach methods—including contacting the media—fairly infrequently (monthly or less), again suggesting that they may be reacting to communication events rather than shaping them.

The majority of respondents disagreed with the statement that the public should be encouraged to leave risk management decisions to the professionals, but no methods to solicit input were used with any frequency. This may indicate the flexibility that is important when dealing with a variety of audiences, or it may suggest that little time is spent in soliciting public input and even less in developing plans and policies on how to solicit input. □

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Capacity of US Labs to Provide TLI in Support of Early HIV-1 Intervention

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ABSTRACT

We surveyed laboratories to assess their capacity to perform T-lymphocyte immunophenotyping. Of the 1026 respondents, 279 located in 41 states and the District of Columbia performed this type of testing. Most laboratories were located in hospitals, reported a low weekly test volume, and indicated that it took 6–24 weeks for flow cytometer operators to become proficient. Many laboratories appear to have the capacity to perform additional CD4+ cell testing, but training additional operators may be necessary. The paucity of laboratories performing T-lymphocyte immunophenotyping in the public sector may affect referral patterns from that setting. (*Am J Public Health* 1991;81:491–494)

Introduction

In 1989, the US Public Health Service recommended that all persons infected with human immunodeficiency virus type-1 (HIV-1) have CD4+ cell counts performed at least every six months.[1] This recommendation is based upon the knowledge that CD4+ cell counts are a major predictor of disease progression in HIV-1 infection,[2] and that information provided by this test is used to make therapeutic decisions about initiating antiretroviral therapy and prophylactic therapy for *Pneumocystis carinii* pneumonia.[3] Because CD4+ cell counts are currently performed by flow cytometric analysis, a technique that is not commonly used in many laboratories, a survey was conducted by the Division of Laboratory Systems, Public Health Practice Program Office (PHPPO) of the Centers for Disease Control (CDC) to learn more about the national availability of this testing and about testing practices in the laboratories currently providing CD4+ cell testing services.

Methods

In August 1989, 1,658 laboratories were surveyed to learn more about their T-lymphocyte immunophenotyping (TLI) testing practices; 1,348 were currently enrolled in a voluntary HIV-1 antibody testing performance evaluation program conducted by the CDC,[4] and 310 were enrolled in a flow cytometry proficiency testing program sponsored by the College of American Pathologists (CAP). The sur-

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TABLE 1—Percentage Distribution of Laboratories Performing and Not Performing TLI, according to Type of Laboratory

Type of Laboratory	% Performing TLI (N:279)	% Not Performing TLI (N:747)	Total % (N:1026)
Hospital, non-blood bank	60	28	37
Blood bank	12	33	27
Independent	15	18	17
Health Department	1	13	10
Research	7	2	3
All Other	5	6	6
Total	100	100	100

TABLE 2—Frequency of Weekly T-Lymphocyte Immunophenotyping Test Volume* by Laboratory Type

	Number (%) of Samples Tested Weekly			
	<50	50–199	200–500	>500
Hospital, non-blood bank (N=167)	117 (70)	41 (25)	—	9 (5)
Blood bank, hospital (N=26)	21 (81)	5 (19)	—	—
Blood bank, non-hospital (N=5)	3 (60)	2 (40)	—	—
Independent laboratory (N=42)	16 (38)	16 (38)	4 (10)	6 (14)
Research laboratory (N=20)	9 (45)	8 (40)	—	3 (15)
Health department (N=4)	3 (75)	1 (25)	—	—
Other/multiple response (N=9)	3 (33)	5 (56)	—	1 (11)
Total	172 (63)	78 (29)	4 (1)	19 (7)

*Does not include missing or incomplete data; therefore, N may be smaller than total sample.

veys, which were identical, were mailed independently. Laboratories that may have received one from both sources (i.e. enrolled in both programs) were requested to respond to the CDC survey only. Prior to data entry, obvious duplicate surveys (i.e. same laboratory name and address) were removed. After data entry, additional duplicate surveys were detected by examining for identical survey responses, across mailings, for laboratories which had the same postal zip codes; duplicate responses were removed from the data base. A total of 1,026 unduplicated surveys were available for analysis: 908 were from laboratories enrolled in the CDC-funded program and 118 were from laboratories which were enrolled in the CAP program, but not in the CDC program.

Results

TLI was performed by 279 (27 percent) of the laboratories, 116 from the CAP program and 163 from the CDC program. Information available on 734 of the 747 respondents not currently performing TLI testing indicated that 12 percent were considering providing this type of testing on-site within the next 12 months. Currently, 45 percent of the laboratories not performing TLI on-site offer the test through referral—most often (70 percent) to a commercial laboratory.

Table 1 shows the percentage distribution of laboratories performing and not performing TLI, by type, for the 1,026 laboratories returning surveys. Non-blood bank hospital laboratories (relative risk [RR] = 2.1; 95 percent confidence interval [95% CI]: 1.8, 2.5) and research laboratories (RR = 4.1; 95% CI: 2.1, 8.2) were more likely to perform TLI testing and health department laboratories (RR = 0.1; 95% CI: 0.04, 0.3) and blood banks (RR = 0.4; 95% CI: 0.3, 0.5) were less likely to do so.

TLI testing laboratories were located in 41 states and the District of Columbia, with the states of California, Texas, New York, Ohio, Pennsylvania, and Florida representing 39 percent of all TLI testing laboratories responding. Comparing the distribution of TLI testing laboratories by state to that state's AIDS rate for May 1989–April 1990,[5] a positive correlation was noted (Spearman rank correlation coefficient = .39, $p < 0.01$). Eighty-three percent of the laboratories reported that they tested specimens from an "off-site" location, i.e. not collected within the institution providing care.

In general, laboratories reported a low weekly testing volume (Table 2). Sixty-three percent of all respondents reported testing fewer than 50 samples per week and 38 percent of that group actually tested fewer than 10 samples weekly. High-volume testing (>500 samples per week) was noted in 15 percent (9/62) of independent and research laboratories—more frequently than in the 5 percent (10/211) of other types of laboratories (RR = 3.1; 95% CI: 1.3, 7.2).

Of those laboratories performing TLI testing, 82 percent had been testing for more than one year and 18 percent for one year or less. Not surprisingly, laboratories that have been performing TLI longer had higher weekly testing volumes. Forty percent (91/227) of laboratories that have performed TLI longer than one year tested 50 or more samples per week compared with 20 percent (10/49) of laboratories that have performed TLI one year or less (RR = 2.0; 95% CI: 1.1, 3.5).

When questioned about their routine sample staining protocol, some laboratories reported using more than one protocol, but most laboratories (75 percent) reported that their routine sample staining protocol was to stain whole blood samples, then lyse red blood cells. Eleven percent reported that they lyse red blood cells first and then stain samples, and 22 percent reported that they stain the sample after mononuclear cells have been separated by density-gradient centrifugation. When asked what cell markers were included in the normal battery of tests performed on each patient sample, the following observations were noted: CD4 (99%); CD8 (99%); CD3 (75%); CD2 (62%); CD19 (50%); CD20 (42%); CD45 (38%); DR (28%); CD14 (26%); NKH-1 (24%); CD57 (13%); 4B4 (11%); and Leu 19 (11%). The reported frequencies for other cell surface markers were less than 10 percent.

Self-reported quality assurance practices indicated that 97 percent of the laboratories had written protocols for specimen collection; 98 percent had protocols for routine calibration of their flow cytometers; and most (87 percent) performed instrument calibration daily. Ninety-one percent of laboratories performing TLI participated in an external proficiency testing program.

When questioned about the sources of training for persons performing TLI, the two most ~~frequent~~ types of training reported were instrument manufacturer's training school (84 percent) and in-house (83 percent). However, 48 percent of TLI laboratories reported taking advantage of courses offered by universities, professional societies, and industry (other than the instrument manufacturers). When questioned about the length of time needed for flow cytometer operators to become proficient in performing TLI testing, the responses range from one-to-five weeks to greater than 18 months—although 55 percent reported a range of six-to-24 weeks. Fifty-four percent (121/225) of the laboratories with longer than one year of TLI testing experience reported that four months or more were needed for the operator to become proficient, while only 31 percent (15/49) of the laboratories with a year or less testing experience reported that this same level of experience was required to successfully perform TLI (RR = 1.8; 95% CI: 1.1, 2.7).

Discussion

Early medical intervention in HIV-1 infection marks a new phase in our experience with the epidemic of acquired immunodeficiency syndrome (AIDS) in which efforts to prevent the spread of HIV-1 through counseling and testing will become integrated into medical treatment and case management. In addition to the obvious medical benefits of improving the health and longevity of infected persons, it has been suggested that early treatment programs targeted to persons who are already infected with HIV-1 might significantly augment current prevention efforts by providing further opportunities for behavioral intervention, thereby resulting in decreased viral transmission to others.[6]

To achieve the goal of providing appropriate and timely medical and psychosocial services to all individuals who are infected with HIV-1, it will be necessary to ensure that the capacity for service exists and that adequate delivery systems are in place. A 1989 policy analysis of the impact of Public Health Service recommendations for prophylactic treatment of *Pneumocystis* pneumonia indicated that "State, regional, county, and city governments will need to coordinate and plan" for the provision of health services required to support these recommendations.[7] This planning must encompass all relevant health care disciplines, including the laboratory which plays a critical role in the diagnosis and prognostic assessment of persons infected with HIV-1.

Because recommendations for both antiretroviral therapy and *Pneumocystis* prophylaxis are based upon the level of CD4+ cells in the peripheral blood, this laboratory test plays a critical role in early intervention efforts. The provision of CD4+ cell testing services to support early HIV-1 intervention efforts will require: adequate instrument capacities, adequate numbers of trained laboratory personnel, access (either direct or through referral) to CD4+ cell testing services by health care workers providing care to HIV-1 infected persons, including those at counseling and testing sites, and financial resources to support this service, especially for indigent persons who are HIV-1 infected.

This survey indicates that many laboratories across the nation are already performing CD4+ cell testing, and laboratories appear to have the capacity to perform additional testing. Obviously, our survey does not include all of the laboratories currently performing CD4+ cell testing. At the time this survey was conducted, we estimate that nearly 1,000 laboratories were performing CD4+ cell testing by flow cytometry (personal communication: Jeffrey Johnson, Program Resources Inc). Therefore, our survey sample probably represents at least 30 percent of all laboratories currently performing this test.

Assuming financial resources are available, the ability to perform additional TLI testing is a function of both instrument and personnel capacity. According to experts in flow cytometry, it is estimated that one fully-trained person should be able to test at least 10 specimens (six markers per specimen) within an 8-hour period. (Personal communication: Dr. Janet Nicholson, Centers for Disease Control.) Although our survey suggests that there may be equipment capacity to accommodate additional testing, it is likely that new personnel will have to be trained to provide for these services. As such, it is interesting to note that laboratories with more experience in performing TLI tended to give longer estimates of time to achieve flow cytometer operator proficiency than those laboratories which have had less experience in the field. There are several probable reasons for the observed range of responses. Experienced laboratories may have older equipment that required more training to learn how to operate compared to newer equipment which tends to be more "user friendly." Also, laboratories with less experience in TLI testing may underestimate the time that it takes operators to become truly proficient in this procedure. And finally, experienced operators may realize that, even with newer equipment, operator training is requred to ensure that the equipment is providing valid results.

These findings should not be interpreted to imply that adequate capacity exists to provide all of the TLI testing needed, only that instrument capacity exists to perform additional testing. The exact need for this testing is still not known, but will depend upon the number of HIV-1-infected persons and the stage of their illness. Untreated individuals who have been infected for longer periods will experience a more rapid decrease in the CD4+ count[8] and may therefore require TLI testing more frequently than twice yearly.

It is apparent from this survey that many of the laboratories which have capacity to perform additional TLI testing are not located in departments of public health. Therefore, bringing together counseling and testing services with medical treatment for early intervention will require a close coordination of services between the entry level of identifying persons who are infected with HIV-1, much of which takes place in the public sector, and the subsequent medical evaluation and provision of care which often takes place in the private sector. Efforts to prevent secondary morbidity and mortality by implementing early HIV-1 intervention programs will involve the assurance that reliable CD4+ cell testing services are available, either directly or through referral, to health care providers treating HIV-1 infected persons.

When HIV-1 counseling and testing takes place in a physician's office, individuals who are found to be infected can be further evaluated or referred for evaluation to determine whether the degree of their immunodeficiency, as determined by CD4+ cell testing, warrants antiretroviral therapy[9] and/or prophylactic therapy to prevent *Pneumocystis carinii* pneumonia.[1] However, considering that less than 4 percent of the publicly funded HIV-1 counseling and testing provided between January 1988 and September 1989 took place in private physician's offices and clinics,[10] it is unlikely that this scenario will apply to the majority of persons who are found to be infected with HIV-1.

Between January 1988 and September 1989, it is estimated that freestanding HIV-1 counseling and testing sites and clinics for the treatment of sexually transmitted diseases (STD) accounted for 65 percent of all publicly funded HIV-1 counseling and testing and 69 percent of all positive tests.[10] One way to ensure that HIV-1 infected persons identified by these programs have physical access to necessary CD4+ cell testing services is by developing a case-management system in which case managers are dedicated to coordinating and monitoring the referral of HIV-1 infected persons into systems which provide medical evaluation and, where appropriate, treatment.

Another option is to expand the provision of TLI testing in the public sector. Participants at the Fifth Consensus Conference on Testing for Human Retroviruses, hosted by the Association of State and Territorial Public Health Laboratory Directors, recommended that "State and local public health laboratories should be making plans immediately for provision of flow cytometric measurement of CD4+ cells" (Fifth Consensus Conference on Testing for Human Retroviruses, March 1990). Some states have already begun to explore this possibility,[7] although it may be practical only in those states with a large number of HIV-1 infected persons. Because storage time and temperature of the specimen may affect T-lymphocyte counts,[11] problems arising from specimen transport to distant sites may limit the degree to which this service can be centralized. Other states may opt to contract with independent commercial laboratories or with local laboratories in tertiary care facilities for the provision of high-quality TLI testing to HIV-1 infected persons.

Many of the concerns about provision of CD4+ cell testing would be minimized by simpler, less costly, tests. Although a number of other biologic markers have prognostic implications in persons infected with HIV-1, none to date have been shown to be superior to CD4+ cell enumeration.[2,12] Therefore, it is unlikely that CD4+ cell testing will soon be replaced as the major source of laboratory information about when to initiate therapy in persons with HIV-1 infection.

Regardless of the approaches taken, implementing early intervention activities by bridging the gap between identifying HIV-1 infected persons and providing medical care to these persons will involve the allocation of additional resources to provide the necessary laboratory services. It is unlikely that private insurance alone will be able to finance the laboratory services needed to achieve early intervention for all HIV-1 infected persons, thus public sector support may be needed. □

Acknowledgments

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Response of Hospitals, Skilled Nursing Facilities, and Home Health Agencies in Oregon to AIDS: Reports of Nursing Executives

Caroline McCoy White, DrPH, and Marie C. Berger, PhD

ABSTRACT

To describe experience and readiness to provide care for persons with acquired immunodeficiency syndrome (AIDS), responses to a mailed survey from 86 percent of chief nursing executives of the 207 hospitals, skilled nursing facilities (SNFs) and home health agencies (HHAs) in Oregon were summarized. As of January 1989, 44 percent reported having provided care; even in low incidence counties, 64 percent of hospitals had provided care. Adequate resources were reported by 79 percent in hospitals, 26 percent in SNFs, and 69 percent in HHAs. (*Am J Public Health* 1991;81:495–496)

Introduction

Developing resources for providing care to persons infected with the human immunodeficiency virus (HIV) or having acquired immunodeficiency syndrome (AIDS) is a societal concern. In Oregon, while the incidence of AIDS is not high on a per capita basis (697 cases reported by December 31, 1989 and a population of 2,687,000[1]), there is a significant and growing population for whom services must be provided. It challenges all health care institutions in Oregon.

Because nursing care is a critical component of the services that persons with AIDS require, we wanted to ascertain the extent to which agencies providing nursing services had cared for persons who had AIDS; and identify factors inhibiting care of AIDS patients. Chief nurse executives (CNEs) were selected as informants because they are responsible for developing policies and allocating resources for nursing care; they are also influential in the decisions made in their agencies.

Methods

In January 1989, we mailed questionnaires to CNEs of all hospitals (n = 79), skilled nursing facilities (whether or not hospital-associated, n = 66), and home health agencies (whether or not hospital-associated, n = 62) licensed and located in Oregon. The questionnaire probed the agency's current experience with providing care and resources to care for persons with AIDS; the overall impact of the epidemic on the agency; and the future role of the agency as perceived by the CNE. The questionnaire had both a prescribed format for response and opportunities for comments. After the second mailing and telephone follow-up, and eliminating the blank questionnaires, the over-all response rate was 86 percent. The CNEs whose responses were used for analysis represent 97 percent of hospitals, 76 percent of skilled nursing facilities, and 84 percent of home health agencies in Oregon. They include 81 percent of the 100 agencies (95 percent of hospitals, 77 percent of SNFs and 67 percent of HHAs) in high prevalence areas (defined as those counties where cumulative numbers of reported cases were 11 or more as of December 31, 1988[2]) and 92 percent of the 107 agencies (100 percent of hospitals, 74 percent of SNFs and 95 percent of HHAs) in low prevalence areas.

Results

Even though Oregon has a moderate prevalence rate for AIDS (251.6 cases per million population in 1989[1]), in early 1989 44 percent of the 207 agencies reported having provided care for persons with AIDS (Table 1). This includes 89 percent of the hospitals and 81 percent of HHAs in high incidence areas, but only 8 percent of the SNFs regardless of location. Even in low incidence counties, 64 percent of hospitals had provided care to persons with AIDS.

CNEs were asked to check specific agency resources for the care of AIDS patients and implementation of universal precautions (Table 2). As a group, CNEs of hospitals reported relatively more resources for supporting care than did those of either the SNFs or home health agencies. More resources were reported for agencies in high incidence areas.

In order to identify factors inhibiting provision of care to persons with AIDS, a list of nine items was presented. The four most frequently cited are shown (Table 2). Proportionately more CNEs of SNFs indicated that these factors were relevant in their situations.

In response to forced choice options to describe the impact of the epidemic, at

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TABLE 1—Numbers of Chief Nursing Executives Reporting Agency Experience Caring for Persons with AIDS by Agency Type and Location in County of High or Low Prevalence of AIDS, Oregon, 1989

	Hospitals		SNF		HHA	
Prevalence[a]	High (n = 35)	Low (n = 42)	High (n = 30)	Low (n = 20)	High (n = 16)	Low (n = 36)
Experience with care[b]						
Yes	31	27	3	1	13	16
No	2	8	18	14	2	15
Don't know	2	5	7	4	1	3

[a] On basis of cumulative number of reported cases by county of residence at onset of symptoms (low = 10 or less; high = 11 or more) (Ref. 2).

[b] For hospitals, experience in providing care includes both inpatient and outpatient care. For skilled nursing facilities (SNF) experience refers to inpatient care only. For home health agencies (HHA) experience includes both home care and hospice care.

TABLE 2—Numbers of Chief Nursing Executives Reporting Resources for Care, and Current Issues by Agency Type and Location in County of High or Low Prevalence of AIDS, Oregon, 1989

	Hospitals		SNF		HHA	
Prevalence[a]	High (n = 35)	Low (n = 42)	High (n = 30)	Low (n = 20)	High (n = 16)	Low (n = 36)
Resources for care						
Good compliance with universal precautions	25	29	11	4	11	21
Committee	27	26	10	7	7	11
AIDS specialist	11	8	2	1	3	6
Adequate policies & resources	27	34	10	3	12	24
Current Issues Inhibiting Care of AIDS Patients						
Confidentiality	16	22	13	13	2	11
Inadequate reimbursement	3	10	11	11	5	6
Lack of resources for staff education	2	5	5	3	2	8
Staff, patients & families might shun agency	0	3	14	15	1	5

[a] On basis of cumulative number of reported cases by county of residence at onset of symptoms (low = 10 or less; high = 11 or more) (Ref. 2).

least 40 percent of CNEs in each agency group reported that the epidemic had little or no effect on their agencies. Comments reflected the basis for judgement about low impact: either the agency had not provided care to persons with AIDS or their numbers had been few. However, other comments noted the extensive effort required for writing and implementing policies and procedures for universal precautions.

In assessing anticipated future roles of agencies in response to the epidemic, CNEs of 29 percent of hospitals, 18 percent of SNFs and 37 percent of HHAs anticipated that their agencies would be "at the forefront." This perception was reported by proportionately more CNEs from high prevalence areas where anticipation of being in the forefront was reported by 35 percent from hospitals, 27 percent from SNFs and 46 percent from HHAs.

Discussion

If the Oregon experience is generalizable, agencies in low incidence areas in moderate and low incidence states should expect to provide care for persons with AIDS. And, if SNFs are to be future resources for care for persons with AIDS, the responses of CNEs in these facilities suggest that a concerted effort is needed to market the idea to their sponsors; the fears they expressed point to the need for further community education and involvement.

These data should alert policy-makers about preparedness for providing nursing services to persons with AIDS. At all levels policy-makers must develop a new spectrum of coordinated services across agencies that provides support to nursing care with "models that are effective and attractive to both patients and nurses."[3] □

Acknowledgments

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Mass Flea Outbreak at a Child Care Facility: Case Report

Larry D. Corpus, PhD, and Kathleen M. Corpus, PhD

ABSTRACT

Cat fleas, *Ctenocephalides felis* Bouchet, were collected at a Mississippi child care facility after reports of large numbers of adult fleas occurring on children and personnel. One building yielded 161 (99 percent) of the fleas collected. Urticarial lesions due to flea bites occurred on the legs of six children. Flea presence was due to cats occupying the crawl space. Fleas were eradicated by eliminating entry of cats and using residual insecticides throughout the facility. (*Am J Public Health* 1991;81:497–498)

Introduction

Cat fleas, *Ctenocephalides felis* Bouchet, are common obligatory ectoparasites, often evident in homes where pets are kept. Their role in host annoyance and disease transmission is well documented.[1] Mass emergence of adults can occur if population numbers are suitably high and environmental conditions are optimal.[1,2] Outbreaks are rarely noted in the literature, although several entomologists consulted could recall anecdotal occurrences of mass flea emergence. In this paper, we report on a case which occurred at a child care facility in northeast Mississippi.

Methods and Results

Case Report

The child care facility occupies two buildings separated by a playground. Children 6 months to about 3 years of age occupy Building 1; children 3 to 4 years of age use Building 2. Both buildings date from the 1940s and were originally private homes constructed of wood clapboard set upon brick walls surrounding conventional foundations. Plumbing and air handling systems are in crawl spaces with access through doors below exterior stairways.

On July 25, 1988, several children from Building 2 entered the playground. One child returned almost immediately screaming that fire ants were crawling on her legs and biting her. Fire ant mounds had been removed from the playground on several occasions. About 50 insects were estimated to be on the child's legs, and were believed at first to be fire ants. However, when the director brushed the insects off and noticed that they "hopped" onto her arms and that similar insects were on her own pant legs, she concluded that they were fleas rather than fire ants. At the same time, four other children ran to the stairs from the playground indicating that they too, had "fire ants" and "bugs" on their legs and were being bitten. As many fleas as possible were removed from the children and everyone went indoors. A pest control company was contacted, but the premises were not treated until the following day.

On July 27, a maintenance worker entered the crawl space under Building 2 to perform routine equipment maintenance, and was later noted sitting on the outside stairs brushing fleas off his uniform. On July 28, reports were received from parents of children about fleas in their homes "biting everyone."

Physical evidence of flea bites was reported after August 2. Six children showed advanced cases of ulcerative sores on their legs, with the number of bites ranging from one to four per leg. Four of the six children exhibiting flea bites were in the initial group which entered the playground on July 25. Most children were not affected since facility personnel chose to remain indoors from July 25 to August 12, a period of 14 days. No adults reported any lasting effects of flea bites beyond brief itching around their ankles and knees. Only one child from Building 1 exhibited any flea bite symptoms, bearing a group of three urticarial lesions on the inside of his right ankle.

The senior author, notified of the flea problem on August 4, visited the site on August 5. Personnel were interviewed and collection of fleas initiated While standing in the playground, 35 adults fleas were removed by aspiration from pant legs and socks. It was discovered that only a narrow band around each building had been sprayed with chlorpyrifos by the pest control company on July 26. On August 12, after all children, parents, and personnel had left the premises for the weekend, the entire facility was treated with propetamophos (Safrotin) and precor indoors, propetamophos and chlorpyrifos outdoors including the playground, and diazinon dust throughout the crawl spaces.

Adult fleas were removed from clothing and placed into 70 percent ethanol. Litter samples were taken from under each building and throughout the playground and berlesed (heat extraction) for

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TABLE 1—Numbers of Adult and Larval (in parentheses) Fleas Collected from Building 2

Date	Collecting Method Berlese	Dry Ice	Aspiration
Aug 5	-	-	35
Aug 8	5 (5)	2	43
Aug 10	17 (8)	4	21
Aug 15	8 (2)	1	7
Aug 17	0 (1)	0	2
Aug 19	0	0	0
Aug 22	0	0	0
Aug 24	0	0	0
Aug 26	0	0	0
Total	30 (16)	7	108

two weeks. Dry ice in white enamel pans was placed in the crawl spaces below each building. Continued collection and monitoring of fleas occurred until August 26 even though no fleas were detected in any stage after August 16.

Identification of the fleas indicated that they were cat fleas, *Ctenocephalides felis* Bouchet (Siphonaptera:Pulicidae). The number of fleas collected from Building 2 for the period August 5 to August 26 are shown in Table 1. Adult fleas comprised the majority of individuals collected (90.2 percent), whereas larvae, all from the crawl space, accounted for only 9.8 percent of the total. Only two adult fleas were collected adjacent to Building 1. The disproportionate number of flea larvae and adults collected from Building 2 suggests that adult fleas were originating from below Building 2. Both the maintenance worker and the senior author attracted fleas while under Building 2, but not while under Building 1. Most of the fleas (98.6 percent) were collected during the first four collecting dates. No flea pupae were collected.

Discussion

The most probable explanation for the greater number of fleas around Building 2 was the presence of several cats in the vicinity on several previous occasions and their continued use of the crawl space. Cats from surrounding buildings roam freely during the day and night and had been trapped near Building 2 on several previous occasions. Fur, feces, and masticated rodent remains below Building 2 further attested to the presence of cats. Cats had entered through open vent holes in the foundation and occupied the crawl space so that eventually a substantial population of fleas had built up. Since similar conditions did not exist at Building 1, very few fleas occurred near it.

Although *Ctenocephalides* spp. fleas have the potential to vector a number of diseases,[2,3] those collected in this case were not tested for pathogens. It was recommended that, in the future, better chemical control measures be used in a more timely manner and that all openings into the crawl spaces below each building be closed off with at least a fine mesh screen. We further suggested that trapping of free-ranging pets be continued, and leash ordinances be enforced in order to reduce or eliminate potential flea hosts. ☐

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Any mention of a proprietary product does not constitute an endorsement.

Mississippi Agricultural and Forestry Experiment Station Contribution Number J-7325.

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Impact of Work on the Quality of Life of Community-Residing Young Elderly

Hirsch S. Ruchlin, PhD, and John N. Morris, PhD

ABSTRACT

Using a random sample of 310 Massachusetts community-residing elderly between the ages of 65 and 74, this study investigates the relationship between employment status and quality of life using a modified version of the Spitzer Uniscale QL index. The odds of reporting the highest quality of life rating, after controlling for socioeconomic and health characteristics, was 3.51:1 for those who worked versus those who did not do so. (*Am J Public Health* 1991;81:498–500)

Introduction

A desire to work beyond the expected age of retirement has become more prominent in recent years.[1,2] Predictions of labor shortages and growing competition for those willing and able to work[3] has directed attention to the continued labor force participation of older people and to the potential reemployment of retirees. Maloney and Paul assert that greater opportunities to work could improve the quality of life for older people.[4] They note that nearly half of the nonworking adults between the ages of 55 and 64 reported that they would have preferred to continue working. Those who stopped work involuntarily said that they were less sat-

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TABLE 1—Distribution of Quality of Life Ratings

Quality of Life Rating	Total	Working	Not Working
1 (lowest)	0	0	0
2 (low)	1	0	1
3 (low middle)	0	0	0
4 (middle)	17	1	16
5 (high middle)	14	2	12
6 (high)	79	8	71
7 (highest)	199	66	133
Total	310	77	233

TABLE 2—Factors Associated with the Odds of Reporting the Highest Quality of Life Rating

Variables	Odds Ratio (95% CI)
Sex	1.02 (0.57,1.81)
Marital Status	1.41 (0.79,2.53)
Self-Assessed Health Status	3.39 (1.78,6.48)
Functional Status	8.29 (2.18,31.48)
Self-Assessed Financial Status	1.55 (0.88,2.74)
Work Status	3.51 (1.67,7.34)

CI = Confidence Interval

isfied with their lives than those who chose either to continue work or to retire.

Evidence to support the hypothesis that work has a positive impact on the elderly's quality of life is limited. Most of the literature focuses on whether retirement leads to increased mental health problems.[5-12] One study conducted by Soumerai and Avorn adopted an employment rather than a retirement focus.[13] Based on a sample of 55 individuals (25 experimentals and 30 controls) they report higher life satisfaction index scores for the experimental (i. e. work) group.

We report here a study of the relationship between employment and quality of life among those elderly who are most likely to be interested in working—those in the age group 65 to 74.

Methods

The Sample

Our data come from a representative sample of Massachusetts community elderly assembled by the Department of Social Gerontological Research, Hebrew Rehabilitation Center for Aged which spans the period 1982–87 (baseline n = 2,682). The sample was constructed by: dividing the state into its 27 home care areas; stratifying areas by size (small, medium, and large) and randomly selecting cities and towns from each area; and randomly selecting for each selected area residents 60 years of age and older from within two age strata (under 70 and 70 and over) from the state census. Data in the sample were obtained through telephone interviews.

The analysis in this study is limited to 1987 data and to individuals under age 75 in 1987 (n = 351). Individuals not in a community setting (n = 24) or who never worked (n = 17) were excluded, leaving a study sample of 310 people: 77 employed (24.8 percent) and 233 (75.2 percent) not employed. The mean age of these two groups was 69.8 years (SD ± 2.3) and 70.3 years (SD ± 2.3). Among those employed, 21 (27.3 percent) worked full-time and 56 (72.7 percent) part-time.

Study Variables

Quality of life, the study's dependent variable, was measured by a self-reported, broad-based, well-established measure—the Spitzer Uniscale QL index—using the scoring metric developed by Morris and Spitzer for use in a general community population. The Uniscale QL has been used with a number of different elderly populations including those with and without serious disabilities,[14,15] and has high interrater reliability and excellent validity properties when compared against other quality of life indicators.[14] It is described in Appendix A.

The independent variables used were: sex, marital status, a self-assessed overall health rating, functional status, a self-assessed rating of financial status, and work status. The coding of these variables and their descriptive statistics are reported in Appendix Table A2.

Results

Quality of Life Rating by Work Status

The distribution of quality of life ratings are reported in Table 1. Approximately 90 percent of the sample reported quality of life ratings in one of the two top categories. By work status, 85.7 percent of the working elders (95% CI = 77.9, 93.5) reported the highest quality of life rating compared to 57.1 percent of the nonworking elders (95% CI = 50.7, 63.5). Focusing on the two highest quality of life ratings, 96.1 percent of the working elders (95% CI = 91.8, 100) were in this range compared to 87.6 percent (95% CI = 83.4, 91.8) of the nonworking elders. No significant differences emerged in a separate analysis of quality of life ratings by extent of work (i.e. full- or part-time).

Impact of Work on Quality of Life

Logistic regression was used to assess the impact of the independent variables on the likelihood of reporting the highest quality of life rating of 7 versus ratings of 1 through 6. The odds ratios associated with each of these variables are reported in Table 2. Three variables display definite impacts—self-assessed health, functional status, and work status. Adjusting for other factors included in the analysis, the likelihood of an elderly person who is working either full-time or part-time displaying the highest quality of life rating is 3.51 times that of an elderly person who is not working.

Discussion

Two health-related factors emerged as associated with the highest quality of life profile: self-assessed health, and functional independence. Working also emerged as a very important element. While work produces extra income to supplement Social Security and pension or investment income, financial security per se was not a significant correlate of a very high quality of life profile. We suggest that the feeling of "usefulness" and "value" traditionally associated with having a job underlies the work-quality of life relationship reported here.

Our results, which clearly await replication from studies that span a broader geographic base and time horizon, indicate that efforts at improving the life of the growing number of "young elderly" (i. e. people in the 65–74 age range) encompass programs that help people over the age of 65 stay on their current job or find new employment that better meets their current needs and capabilities. Such efforts will contribute to the improved social and mental health of the elderly. □

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APPENDIX

In its self-report version, Uniscale QL scores quality along a seven-category continuum based on a response to the following question: "How would you rate your overall quality of life? Think of a ladder with 7 rungs, where the first, lowest rung applies to someone completely dependent physically on others, seriously impaired mentally, unaware of surroundings, and in a hopeless position. At the top of the ladder, the 7th rung applies to someone physically and mentally independent, communicating well with others, able to do most of the things enjoyed, pulling one'sown weight, with a hopeful yet realistic attitude. Where would you place yourself on this 7-rung ladder?" The distribution of the self-report Uniscale QL index for a representative sample of community elders in Massachusetts is reported in Table A1.

TABLE A1—Uniscale QL Distribution for A Representative Sample Of Community Elders in Massachusetts (N = 1,582) (in percent)

		Extent of Functional Disability		
QL Rating	Total Sample	No ADL/IADL Deficit	IADL Deficit/ No ADL Deficit	ADL Deficit
1 (lowest)	0.8	0.1	0.3	11.2
2 (low)	0.6	0.0	0.5	8.8
3 (low middle)	1.3	0.1	5.1	10.5
4 (middle)	4.6	3.7	7.0	12.0
5 (high middle)	20.1	16.3	40.5	33.4
6 (high)	32.2	33.9	31.9	8.7
7 (highest)	40.4	45.9	14.7	15.4
(% of sample)		(82.6)	(11.7)	(5.7)

TABLE A2—Coding of Independent Variables and their Descriptive Statistics

Variable	Coding	Mean	Standard Deviation
Sex	1 = Female 0 = Male	0.558	0.497
Marital Status	1 = Married 0 = Not married	0.600	0.491
Self-Assessed Health Status	1 = Excellent or good 0 = Fair or poor	0.781	0.414
Functional Status	1 = Independent 0 = Dependent^a	0.919	0.273
Self-Assessed Financial Status^b	1 = Good 0 = Fair or poor	0.687	0.464
Work Status	1 = Working 0 = Not working	0.248	0.433

N = 310 except for functional status where n = 309.

a) Dependent in either personal activities of daily living and/or instrumental activities of daily living.

b) Data for this variable were drawn from the responses to the following question: "Would you say that you have enough money to live on with little trouble, just enough to get by, or not enough to make ends meet?" These responses were characterized as good, fair or poor, respectively.

Black-White Differences in Cancer Prevention Knowledge and Behavior

Christopher Jepson, PhD, Larry G. Kessler, ScD, Barry Portnoy, PhD, and Tyson Gibbs, PhD

ABSTRACT

Data from the 1987 National Health Interview Survey Cancer Control Supplement were used to estimate multivariate logistic regression models of diet change, mammography utilization, stool blood test utilization, and smoking. Predictor variables included race, sex, age, income, dietary concerns, and four knowledge-related variables: education and three measures of cancer prevention knowledge. When knowledge variables were included in the models, race was not a significant predictor of behavior, with one exception: among women, Blacks were found to smoke less than Whites. (*Am J Public Health* 1991;81:501–504)

Introduction

Blacks have a higher incidence of and mortality from cancer than Whites.[1,2] This differential presumably reflects differences in demographic factors such as education and income, and cognitive psychological factors such as attitudes and knowledge which influence behavior.

Although studies have shown that Blacks tend to have lower levels of cancer knowledge than Whites,[3-5] the relationship between knowledge level and cancer-preventive behavior has not been adequately documented. Some studies indicate a relationship between knowledge and behavior,[6-9] while others do not do so.[10,11] At minimum, however, some basic preexisting level of knowledge is a prerequisite for any instrumental behavior. Theories such as the Health Belief Model,[12,13] PRECEDE,[14] and Fishbein and Ajzen's theory of reasoned action[15] also postulate a relationship between behavior and beliefs, which are presumably based upon knowledge to some extent.

In 1987 the National Health Interview Survey (NHIS)[16] included a Cancer Control Supplement assessing a variety of demographic and cognitive psychological factors in addition to cancer-preventive behaviors. This made it possible to examine the extent to which such factors were associated with Black-White behavioral differences.

Methods

A total of 22,043 adult respondents over the age of 18 provided data on the 1987 NHIS Cancer Control Supplement. To increase accuracy of point estimates, Blacks were oversampled: 3,053 respondents (13.9 percent of the total sample) described themselves as Black.

For the purposes of our analyses, the study population was restricted to respondents describing themselves as either Black or White; Hispanics and members of other ethnic or racial groups were excluded. This reduced the total number of respondents to 20,088. In the analyses reported here, the data are weighted (using weights assigned by the National Center for Health Statistics) so as to be representative of the US population.[16]

We selected four measures of cancer-preventive behavior as dependent variables. These variables are described in Table 1.

The independent variables selected for our analysis fell into two main categories—demographic (race, sex, income, education, age) and cognitive psychological (knowledge, belief, and attitude) measures. They are described in Table 2. A detailed description is provided in the Appendix.*

In our data analysis, we first examined Black-White differences in the dependent and independent variables, and then estimated logistic regression models of each dependent variable, using a special software program, RTILOGIT,[17] designed specifically for use on data sets of this type.

Results

Black-White Differences

Table 1 reveals substantial Black-White differences in rates of diet change, mammography, and stool blood testing; smoking differences are essentially confined to men. Table 2 shows that Blacks scored lower than Whites on the three knowledge measures and were less likely to believe that cancer is preventable.

Some independent variables, such as the knowledge measures, are continuous. Mean Black-White differences on these variables, shown in Table 2, appear small but when they are dichotomized and percentages are compared the differences are

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*Additional information on standard errors of point estimates presented in this paper, odds ratios, etc., are available upon request from the first author.

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TABLE 1—Distribution of Dependent Variables by Race[*]

Variable	Description	Race[a] Black (n)	 White (n)	OR[b] (95% CI)
Diet change	Self-report of whether respondent has "ever made any lasting and major changes in [diet] for health reasons"	31.3 (2971)	36.8 (17089)	0.78 (0.70, 0.87)
Mammography	Self-report of whether respondent has ever had a mammogram[c,d]	31.2 (907)	40.0 (5524)	0.68 (0.57, 0.81)
Stool blood test	Self-report of whether respondent has ever had a stool blood test[c,e]	31.3 (1448)	39.4 (9320)	0.70 (0.60, 0.82)
Smoking status	Self-report of whether respondent is currently a cigarette smoker	32.4 (2868)	28.7 (16521)	—
	Men only	37.8 (1020)	30.2 (7025)	1.40 (1.15, 1.71)
	Women only	27.9 (1848)	27.2 (9496)	1.04 (0.89, 1.20)

[a] Figures are percentages of Blacks and Whites reporting the given behavior. Respondents who describe themselves as Hispanic or as neither Black nor White are excluded.

[b] Odds ratio = odds of Blacks (vs Whites) reporting the given behavior.

[c] Respondents were first asked if they had heard of the given test. Those answering "no" or "don't know" were counted as never having had the test.

[d] Only women age 40 and over responded.

[e] Only men and women age 40 and over responded.

[*] Data are weighted to be representative of US population.

equal to or greater than those seen for the categorical variables.

Regression Analyses

In order to determine the extent to which knowledge-related factors could account for the relationships between race and cancer-preventive behaviors, we estimated two multivariate logistic regression models of each dependent variable. In the first or reduced model, all independent variables are included except for the four knowledge-related variables (education and the three measures of cancer prevention knowledge). The second or full model includes all of the independent variables in Table 2.

Table 3 shows the coefficients (betas) for all independent variables in the full models of the four dependent variables. The coefficients for race translate into the following odds ratios (i.e. the odds of Blacks reporting the given behavior compared to Whites): for diet change, 0.94 (95% CI = 0.84, 1.05); for mammography, 0.94 (95% CI = 0.77, 1.16); for stool blood test, 1.08 (95% CI = 0.91, 1.28); for smoking among men, 1.03 (95% CI = 0.83, 1.29); and for smoking among women, 0.71 (95% CI = 0.59, 0.85). Thus, in all models except that of women's smoking, Black-White differences in behavior do not persist when the other predictors are held constant.

Among women, race is not a significant predictor of smoking status by itself, as shown in Table 1. As Table 3 shows, however, Black-White differences become significant in the full model.

TABLE 2—Distribution of Independent Variables by Race[*]

Variables	Description	Percent in Population or mean value[a] Overall	 Black	 White
Demographic Factors				
Race	% White	88.1	—	—
	% Black	11.9	—	—
Sex	% Male		44.9	47.7
	% Female		55.1	52.3
Education	Years completed, from 0 (none) to 18 (18 or more)		11.4	12.7
Age	Age in years		40.8	44.6
Square of age			—	—
Family income:				
% Under $10,000			27.1	11.2
% $10,000–$19,999			22.4	18.8
% $20,000–$34,999			20.8	27.3
% $35,000 & over			14.8	31.5
% Unknown			11.9	11.2
Cognitive Psychological Factors				
Fat & fiber knowledge	Maximum score = 8		3.65	4.79
Risk factor knowledge	Maximum score = 7		3.63	4.46
Cigarette risk knowledge	Maximum score = 5		3.62	4.12
Dietary concerns	Maximum score = 3		2.16	1.95
Belief that cancer is *not* preventable:				
% Agree/strongly agree			30.8	20.5
% Disagree			45.0	53.7
% Strongly disagree			9.5	16.9
% No opinion			14.8	9.0

[a] Respondents who describe themselves as Hispanic or as neither Black nor White are excluded. When percentages are given, the variable in question is a dummy variable; when means are given, the variable is continuous.

[*] Data are weighted to be representative of US population.

In the reduced models of each dependent variable, the betas for race are intermediate between those shown in Table 1 and those in Table 3, and all are significantly different from zero.

Discussion

Our results were generally consistent across all dependent variables except for smoking status among women. By includ-

TABLE 3—Beta Values for Independent Variables in Models of Cancer-Preventive Behavior[a]

Variables	Diet change (n = 19596)	Mammography utilization (n = 6238)	Stool blood test utilization (n = 10438)	Smoking status: Men (n = 7885)	Smoking status: Women (n = 11333)
Race	−0.07	−0.06	0.07	0.03	−0.35***
	(−0.18, 0.05)	(−0.26, 0.15)	(−0.10, 0.24)	(−0.19, 0.26)	(−0.52, −0.17)
Sex	0.05	—	−0.04	—	—
	(−0.03, 0.12)		(−0.14, 0.05)		
Age	0.05***	0.13***	0.19***	0.13***	0.12***
	(0.04, 0.06)	(0.08, 0.18)	(0.15, 0.22)	(0.10, 0.15)	b
Square of age	−0.0004***	−0.001***	−0.001***	−0.002***	−0.002***
	b	b	b	b	b
Family income:					
Under $10,000	0.06	−0.32***	−0.04	0.24*	0.49***
	(−0.07, 0.20)	(−0.50, −0.13)	(−0.21, 0.13)	(−0.01, 0.48)	(0.28, 0.71)
$10,000–$19,999	−0.06	−0.16	0.03	0.28**	0.33***
	(−0.18, 0.07)	(−0.36, 0.04)	(−0.11, 0.16)	(0.04, 0.52)	(0.15, 0.51)
$20,000–$34,999	−0.05	0.15	0.05	0.09	0.20*
	(−0.17, 0.08)	(−0.08, 0.38)	(−0.10, 0.20)	(−0.13, 0.31)	(−0.00, 0.39)
$35,000 & over	−0.003	0.34***	0.18**	−0.13	−0.05
	(−0.13, 0.12)	(0.12, 0.56)	(0.04, 0.31)	(−0.37, 0.11)	(−0.22, 0.12)
Dietary concerns	0.52***	0.07**	0.07***	−0.23***	−0.17***
	(0.48, 0.56)	(0.00, 0.13)	(0.02, 0.11)	(−0.29, −0.18)	(−0.22, −0.12)
Belief that cancer is *not* preventable:					
Agree/strongly agree	−0.15**	0.26**	−0.03	0.21	0.31***
	(−0.29, −0.01)	(0.04, 0.49)	(−0.19, 0.13)	(−0.04, 0.47)	(0.11, 0.50)
Disagree	0.12*	0.23**	0.08	0.01	0.11
	(−0.01, 0.24)	(0.02, 0.45)	(−0.09, 0.25)	(−0.22, 0.24)	(−0.10, 0.32)
Strongly disagree	0.53***	0.23*	0.09	−0.06	0.09
	(0.39, 0.68)	(−0.01, 0.48)	(−0.12, 0.30)	(−0.33, 0.21)	(−0.15, 0.33)
Education	0.02***	0.07***	0.06***	−0.11***	−0.10***
	(0.00, 0.03)	(0.04, 0.09)	b	(−0.13, −0.09)	(−0.12, −0.08)
Fat & fiber knowledge	0.09***	0.10***	0.11***	−0.01	−0.02
	(0.07, 0.12)	(0.06, 0.14)	(0.07, 0.14)	(−0.05, 0.02)	(−0.05, 0.02)
Risk factor knowledge	0.08***	0.01	0.02	−0.03	−0.01
	(0.05, 0.10)	(−0.02, 0.05)	(−0.01, 0.05)	(−0.07, 0.01)	(−0.05, 0.02)
Cigarette risk knowledge	0.04**	0.09***	0.09	−0.15***	−0.19***
	(0.01, 0.06)	(0.04, 0.13)	(0.05, 0.13)	(−0.20, −0.11)	(−0.24, −0.15)

[a] Figures are regression coefficients (betas) and 95% confidence intervals (in parentheses).
[b] 95% confidence limits are within .01 of parameter estimate.
$^{*}p < .10$
$^{**}p < .05$
$^{***}p < .01$

ing knowledge-related variables in the analysis, Black-White behavioral differences were eliminated. In the case of women's smoking status, when other factors are controlled for, Black women become less likely than White women to smoke.

In addition to accounting for the effects of race, knowledge-related variables also displayed independent relationships with cancer-preventive behaviors. Education was a significant predictor in all models. Cigarette risk knowledge also contributed significantly in all cases, with its contribution greatest in the models of smoking status. Fat and fiber knowledge was a significant predictor of all dependent variables except smoking status; somewhat surprisingly, it was no more significant for diet change than for the other dependent variables. Risk factor knowledge contributed significantly only to the model of diet change.

The cross-sectional nature of the analysis places significant limitations on the conclusions to be drawn from this study. Associations discovered in such a study cannot be assumed to reflect causal relationships, and it is possible that other variables could account for Black-White behavioral differences as well as or better than the ones we chose to examine. Nevertheless, this study is unique in that it is the first national study assessing the independent effects of knowledge, beliefs, attitudes, and demographic factors on Black-White differences in cancer-preventive behaviors. The importance of cognitive psychological factors is indicated by the fact that even the imperfect measures available to us eliminated the behavioral differences.

Our findings suggest that a fuller understanding of Black-White behavioral differences can be gained by including measures of knowledge and attitudes, especially if these measures assess specific concepts directly related to the behaviors in question. Second, they suggest that there may be merit in investigating the use of interventions designed to narrow the behavioral discrepancies between Blacks and Whites by reducing the knowledge discrepancies. Longitudinal studies of this type should answer the question of whether enhancing cancer knowledge will result in increased cancer-preventive behaviors as a stepping stone to reductions in cancer mortality. ☐

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APPENDIX

Description of Independent Variables

Reported family income was treated as a categorical variable rather than as an ordinal variable because approximately 12 percent of respondents did not provide income data. Respondents who did provide income data were divided into four categories, and each group was assigned a dummy variable; the unknowns served as the reference category.

Three measures of cancer prevention knowledge were created as follows: The first, *fat and fiber knowledge,* represents the number of correct answers to two questions in which respondents were given lists of foods and asked to identify which were sources of fat and fiber. The second, *risk factor knowledge,* was similarly created from an item in which respondents were asked to identify cancer risk factors. The third, *cigarette risk knowledge,* was taken from a set of five items in which respondents were asked to identify diseases caused by cigarette smoking. The reliability of this measure was very high (Cronbach's alpha = 0.90).

An attitude measure of dietary concerns was created from a set of three items in which respondents were asked if avoiding sodium, avoiding sugar, and lowering cholesterol were important concerns for them (alpha = 0.80).

Belief in the preventability of cancer was measured by degree of agreement with the statement, "There is very little a person can do to reduce his or her chances of getting cancer." Respondents were divided into four categories—those who agreed or strongly agreed, those who disagreed, those who strongly disagreed, and those with no opinion—with the last serving as the reference category.

Report of an Association between Race and Thyroid Stimulating Hormone Level

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ABSTRACT

We examined the association between race and thyroid stimulating hormone (TSH) level in 809 consecutive Black or White adults tested for mild suspicion of hypothyroidism with a normal TSH result. The mean TSH level of Blacks was 0.4 (SE .053) mU/L lower than that for Whites after age and sex adjustment, race explaining 6.5 percent of the variation in TSH levels. A validation sample yield similar results. This finding supports the possibility that differences in thyroid function and/or regulation may be associated with race. (*Am J Public Health* 1991;81:505–506)

Introduction

In two recent reports the incidental finding of an association between race and primary hypothyroidism has been noted.[1,2] The odds of both borderline and substantial thyroid stimulating hormone (TSH) elevations were greater among Whites than Blacks, controlling for age and sex. An increased risk of autoimmune thyroiditis among Whites has also been mentioned in thyroid textbooks,[3,4] but supported mainly by old hospital prevalence studies[5,6] with biases likely favoring detection of disease among Whites. Age and sex associations for primary hypothyroidism and autoimmune thyroiditis are well accepted, with previous studies documenting corresponding age and sex associations with TSH levels as well.[7-9] We hypothesized that a similar association would be found between race and TSH levels if there were a substantial racial association for hypothyroidism and autoimmune thyroiditis.

Methods

Subjects were consecutive adult primary care patients of the George Washington University Health Plan that had a TSH level for suspicion of hypothyroidism due to nonspecific symptoms or signs from April 1985 to March 1987. Patients on medications known to affect thyroid function tests or with a history of thyroid disease were excluded. Of 880 such patients identified, 33 were excluded due to an abnormal TSH level and 38 because either no race or one other than Black or White was noted in the medical record. This analysis is restricted to the remaining 809 Black or White patients tested for suspicion of hypothyroidism and found to have TSH levels within normal limits. Categorization of race was generally by patient self-report on the data base form in the chart. The racial demographics of this sample were similar to those of the entire health plan patient population.

The Magic TSH RIA (CIBA Corning Magnetic Immunochemistries, Medfield, MA) with normal limits of 0–5 mU/L was utilized for all TSH determinations obtained during the initial study period. A linear regression analysis was used to test for an association between race and TSH level. The model utilized TSH as the dependent variable, with age, sex, and race as independent variables, and chronic medical problems and/or medication use (both treated as dichotomous variables) as potential confounding factors. An analysis utilizing a log transformation of TSH to normalize the skewed distribution yielded similar results. Interactions between the independent variables were evaluated and a P-value of 0.10 or less was required to remain in the final model in a stepwise procedure.

In August 1989, a validation sample of 97 patients with normal TSH levels was collected at the study site by the same methods. The sample size was calculated to assure a 90 percent power of detecting a 0.4 mU/L difference in mean TSH levels at a 0.05 level of significance. The Magic mab TSH (CIBA Corning Magnetic Immunochemistries), an immunoradiometric sandwich assay with normal limits of 0.3–4.5 mU/L, was utilized for the TSH determinations on this patient sample. The analysis proceeded as described above.

Results

Of the patients from the initial study sample, 406 were Black and 403 were White. The interaction terms did not achieve a P-value of 0.10 or less and were thus eliminated from the final model. Chronic medical conditions and medica-

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TABLE 1—Linear Regression Model of TSH as a Function of Race

Variables	Sample	Coefficient	Standard Error	P-value
Age*	Initial	0.007	0.002	0.004
	Validation	0.006	0.006	0.32
Sex**	Initial	−0.081	0.074	0.27
	Validation	−0.45	0.23	0.06
Race***	Initial	0.402	0.053	<0.0001
	Validation	0.45	0.18	0.01

*In years.
**Coded: female = 0, male = 1.
***Coded: Black = 0, White = 1.

tion use were not significantly associated with TSH levels. Age and race, but not sex, were independently predictive of TSH levels within the normal range (Table 1). Race explained 6.5 percent and age 0.8 percent of the variation in TSH levels. Whites had an age- and sex-adjusted mean TSH level 0.4 mU/L higher than Blacks.

Of the 97 patients in the validation sample, 51 were Black and 46 were White. The regression analysis again reveals an association between TSH level and race independent of sex and age. Race explained 5.5 percent of the variation in TSH levels with Whites having an age- and sex-adjusted mean TSH level 0.45 mU/L higher than Blacks.

Discussion

The present analysis reveals a racial association for TSH levels within the normal range in a population of primary care patients tested for generally mild suspicion of thyroid disease. The fairly large mean difference in TSH levels between Blacks and Whites in the two samples suggests that this association may be of clinical importance and is consistent with previously reported findings of a higher prevalence of borderline and frankly elevated TSH levels in Whites.[1,2] The association between race and TSH level was much stronger than that for age or sex, factors known to be associated with TSH level. An older sample would likely have demonstrated a greater age and sex dependency, however.

It is unlikely that these results are due to chance, given the highly significant P-value and the similar results obtained in the validation sample using the newer super-sensitive TSH assay.

It is possible that biased selection could account for these results since neither data set resulted from a random sampling of the population. This was necessary since, to our knowledge, no data base is available that contains race and TSH data for a normal reference population. However, for such a selection bias to have occurred, presumably euthyroid Whites with TSH levels higher in the normal range than Blacks (controlling for age and sex) must have been preferentially tested in both study samples. We are unaware of any reason for this to have occurred.

Several possible explanations of a racial association for normal TSH levels can be suggested. Environmental factors such as iodide consumption[4] might vary sufficiently between Blacks and Whites in the study population to affect thyroid function and account for the racial association. It is also possible that genetic factors differ between the Black and White patients tested and could account for a difference in TSH levels. Given previously determined relationships between race, gene frequency, and autoimmune disease,[10,11] such an association would not be surprising and has in fact been suggested by one study of post-partum thyroid dysfunction.[12] Population-based data are needed to confirm an association between race and thyroid function, as well as establish a link with antithyroid antibodies or other factors. Such information should be available from the NHANES III database in the future. ☐

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Association of Waist to Hip Ratio and Family History with the Prevalence of NIDDM among 25,272 Adult, White Females

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ABSTRACT

The independent association of waist to hip ratio (WHR), relative weight, and family history with the prevalence of non-insulin dependent diabetes mellitus (NIDDM) was investigated in a population of 25,254 White females in the United States and Canada. A multivariate logistic analysis yielded standardized odds ratios of 1.47, 1.46, 1.54, and 1.14 for family history index, WHR, relative weight, and age, respectively. (*Am J Public Health* 1991;81:507–509)

Introduction

The association between obesity and non-insulin dependent diabetes mellitus (NIDDM) is well established.[1-3] More recent studies have demonstrated an association between the distribution of adipose tissue and NIDDM after adjusting for obesity and other risk factors.[4-11] The studies cited have used the ratio of waist to hip girth (WHR) as a measure of body fat distribution as first proposed by Rimm and Hartz.[4] The present study evaluates the independent associations of WHR, family history, relative weight, and age as they relate to the prevalence of NIDDM.

Methods

In 1969, TOPS (Take Off Pounds Sensibly), an organization of weight conscious women devoted to a responsible approach to weight control, sponsored the administration of an extensive health inventory to their members. The study yielded a total of 73,532 valid completed questionnaires from White females. Further details of the study design and the type of data collected are given elsewhere.[12,13]

Determination of the presence or absence of diabetes was based upon the subjects response of yes or no to the question, "Has a doctor ever said you had diabetes?" A study to assess the validity of the data, indicated that the medical information and anthropometric measurements supplied by the women was not biased by under- or overreporting.[14]

Only those women between the ages of 40 and 70 at the time of the study were included in the present analysis because the majority of cases of NIDDM appear in this age range. The exclusion of insulin dependent women resulted in a total of 25,272 White female subjects.

Weights and current girth measurements were self-reported. Relative weight taken as the ratio of actual weight to ideal body weight for height as given in the Metropolitan Life Insurance Tables[15] medium frame size served as an index of obesity. Relative weight ranged from 80 to 312 percent of ideal weight with a mean value of 1.32 and a median of 1.27. The ratio of waist to hip girth was used as the measure of body fat distribution.

The women recorded presence or absence of a number of diseases in their parents, grandparents, siblings, and children. This was used to calculate a family history index (FHI) for diabetes.[16] The following formula gives the index in terms of presence (= 1) or absence (= 0) of diabetes in the mother (M), the father (F), the brothers (B), the sisters (S), paternal grandparents (PGP), and maternal grandparents (MGP) of the subject.

$$\mathrm{FHI} = (M + F + B + S) + (PGP + MGP)/2.$$

Because of recent evidence associating smoking with increased WHR,[17] it was included in this analysis. Respondents were categorized as nonsmokers, light to moderate smokers, and heavy smokers based upon the number of pack-years smoked.

Subjects were divided into tertiles for WHR (<0.75, 0.75–0.80, and >0.80); they were divided into three groups for both FHI (0.0, 0.5–1.0, and >1.0), and for relative weight (<1.25, 1.25–1.50, and >1.50). This produced a $3 \times 3 \times 3$ matrix with 27 cells. Diabetes prevalence was determined for each of these cells.

Multiple logistic regression was used to evaluate the prevalence of diabetes as a function of age, family history index, WHR, relative weight, and all possible two and three way interactions. While this approach does not delineate interaction to

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TABLE 1—Comparison of Selected Characteristics between Diabetic and Nondiabetic Women from the 1969 National Survey of Members of TOPS Club, Inc[*]

Variables	Diabetic	Nondiabetic	Total population
n	1,345	23,927	25,254
% of total	5.3	94.7	100
Average Age (years)[†]	51.6 ± 7.4	50.3[‡] ± 7.0	50.4 ± 7.1
Average Family History Index[††]	0.72 ± 0.72[**]	0.31[‡] ± 0.31	0.33 ± 0.33
Average Relative Weight	1.45 ± 0.29	1.31[‡] ± 0.25	1.31 ± 0.25
Average Waist: Hip Ratio	0.81 ± 0.07	.78[‡] ± 0.06	0.78 ± 0.06

[*] TOPS Club, Inc., Take Off Pounds Sensibly Club, Inc.

[†] Mean ± one standard deviation.

[‡] $p < .001$ for univariate analysis comparing diabetic to nondiabetic women.

[††] Family history index = no. of diabetic parents and siblings + (no. of diabetic grandparents ÷ 2).

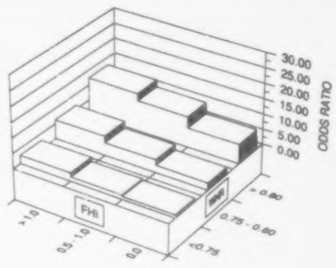
[**] The distribution of the family history index approximates an exponential density distribution in which case the standard deviation is approximated by the mean.

TABLE 2—Prevalence of NIDDM among Women from the 1969 National Survey of Members of TOPS Club, Inc,[*] when Stratified by Relative Weight, Family History Index for Diabetes, and Waist to Hip Ratio

Relative Weight	Family History Index	WHR <0.75	WHR 0.75–0.80	WHR >0.80
0.8–1.25	0.0	1.4 (4484)[**]	2.0 (2711)	3.5 (1768)
	0.5–1.0	3.2 (1250)	5.3 (811)	8.6 (452)
	1.5–5.0	8.2 (352)	8.5 (235)	16.2 (179)
1.26–1.50	0.0	1.9 (1996)	3.0 (2130)	6.5 (1539)
	0.5–1.0	5.5 (550)	6.8 (759)	11.6 (934)
	1.5–5.0	12.3 (199)	9.1 (279)	23.6 (333)
1.51–3.12	0.0	3.6 (408)	7.0 (542)	11.4 (809)
	0.5–1.0	8.1 (125)	11.6 (165)	15.9 (295)
	1.5–5.0	14.8 (44)	24.0 (62)	26.5 (120)

[*] TOPS Club, Inc., Take Off Pounds Sensibly Club, Inc.

[**] Prevalence of NIDDM in percent and, in parentheses, subjects per cell.



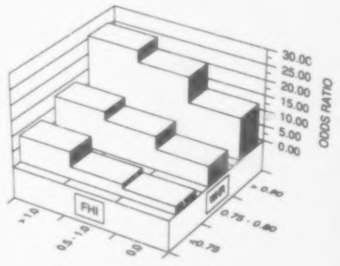


FIGURE 1a—Odds ratios for women between 25 and 50 percent above ideal weight with respect to women less than 25 percent above ideal weight at various levels of family history index (FHI), and waist to hip ratio (WHR) (1969 National Survey of Members of the TOPS Club, Inc)

FIGURE 1b—Odds ratios for women more than 50 percent above ideal weight with respect to women less than 25 percent above ideal weight at various levels of family history index (FHI), and waist to hip ratio (WHR) (1969 National Survey of Members of the TOPS Club, Inc)

the extent provided by calculation of odds ratios of interaction,[16] such an approach is impractical with this number of independent variables.

Results

Table 1 shows that the diabetic women were generally more obese, older, and had a higher FHI than the non-diabetic women. The Pearson correlation between relative weight and WHR was 0.26; WHR has a correlation with age of 0.20, but is only weakly correlated with family history of diabetes (r = 0.04).

Table 2 shows the steady increase in diabetes prevalence associated with increases in relative weight and family history. Prevalence rises from 1.4 percent for women in the lowest categories of WHR, relative weight, and family history to 26.5 percent for women in the highest risk group. Odds ratios increase consistently with WHR and family history when the two higher weight categories are compared to the lowest weight group (Figure 1).

Logistic regression results were standardized by calculating the odds ratios associated with an increase of one standard deviation in the independent variables (Table 3). The standardized odds ratio for diabetes associated with the family history index, WHR, relative weight, and age are 1.47, 1.46, 1.54, and 1.14, respectively. The only significant interaction was a standardized odds ratio of 0.94 for the combination of family history and relative weight. Smoking history was not significantly related to diabetes prevalence.

Discussion

The prevalence of diabetes increases with WHR at all levels of family history

TABLE 3—Multiple Logistic Regression Results for Diabetes Prevalence as a Function of Relative Weight, Family History Index (FHI) and Age and Their Interaction among Women from the 1969 National Survey of Members of TOPS Club, Inc*

Variable	Odds Ratio for One Standard Deviation	95% Confidence Interval
Family History Index	1.47	1.38–1.56
Waist:Hip Ratio	1.46	1.42–1.50
Relative Weight	1.54	1.49–1.59
Age	1.14	1.11–1.18
Rel Wt* FHI[†]	0.94	0.91–.96

*TOPS Club, Inc., Take Off Pounds Sensibly Club, Inc.
[†] No other interactions were significant at the level, $p < .05$.

and similarly increases with increasing family history for the disease at each level of obesity, and both factors show independent associations with diabetes. These conclusions are supported by the logistic regression results.

An odds ratio less than 1 for the interaction of relative weight and FHI indicates that this interaction is less than multiplicative. No other interactions were significant. This implies that the associations between family history, WHR, relative weight, and age are multiplicative in nature.

Gestational diabetes and undiagnosed diabetes as well as other possible sources of bias such as those associated with variations in awareness of family history, the potential for weight change due to TOPS membership, and the possibility of weight gain or loss following the onset of diabetes apparently do not affect these findings.[16] If present, these biases would tend to reduce the strength of the observed associations. □

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NOTE

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